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FINAL REPORT
ON
REVIEW OF THE SCIENTIFIC LITERATURE
AND PREPARATION OF AN ANNOTATED BIBLIOGRAPHY
ON
EFFECTS OF CIGARETTE SMOKING AND NICOTINE
ON HUMAN PERFORMANCE

Volume 2

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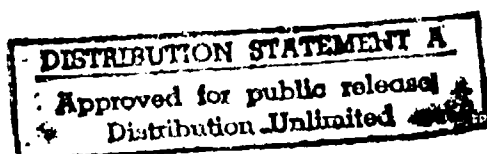
Associate Consultants, Inc.
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Submitted to:

Commander (SGRD-PLC)
U.S. Army Medical Research Acquisition Activity
ATTN: Mr. Henry Holiday
Fort Detrick
Frederick, Maryland 21701-5014

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Richard M. Millis PhD, Principal Investigator
Telephone: 202/737-8062



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AGUE C 483
 CARDIOVASCULAR VARIABLES SKIN CONDUCTANCE AND TIME
 ESTIMATION: CHANGES AFTER THE ADMINISTRATION OF SMALL DOSES
 OF NICOTINE
 PSYCHOPHARMACOLOGIA 37:109-125, 1974

Cardiovascular variables (heart rate, skin conductance, and time estimates) were measured in 24 subjects after smoking cigarettes with different nicotine content. Heart rate and forearm blood flow increases were found to be dose dependent, the latter occurring only after smoking at the fast rate, and their duration simultaneous to the presence of active nicotine in the organism. Skin vasoconstriction, as measured by skin conductance levels (throughout the experimental session) occurred immediately after smoking, but were not related to drug effects. Nicotine did not influence subjective time estimates. A specific pattern of responses occurred. This is discussed in terms of "disruption" of the timing task and a gradual reorganization towards presmoking estimates. The value of psychophysiological indices in relation to drugs of habitual use is questioned.

AGUE C 115
 NICOTINE AND SMOKING: EFFECTS UPON SUBJECTIVE CHANGES IN
 MOOD
 PSYCHOPHARMACOLOGIA (BERLIN) 30:323-328, 1973a

A mood adjective checklist (MACL) and activation scale (AS) were used to measure subjective reports on mood changes in male habitual smokers. Experimental cigarettes were 1 control non-nicotine (lettuce-leaf) cigarette and 3 filter-tip cigarettes. The MACL was sensitive to changes in mood within short periods of time. The AS linked subjective responses to physiological parameters. A positive linear trend was found for the sensation of pleasantness across the nicotine content of cigarettes. All other factors scored on the MACL were insignificant. From the AS, decreases in "inner tension" were related to nicotine content. The effects of the 3 different cigarettes did not differ among themselves. Other subjective factors scored were anxiety, aggression, concentration, fatigue, sadness, surgency, and vigor.



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AGUE C 499
 SMOKING PATTERNS, NICOTINE INTAKE AT DIFFERENT TIMES OF DAY
 AND CHANGES IN TWO CARDIOVASCULAR VARIABLES WHILE SMOKING
 CIGARETTES
 PSYCHOPHARMACOLOGIA 30:135-144, 1973b

Subjects were healthy male volunteers, aged 17-24 years. Doses of nicotine inhaled were estimated by calculating the nicotine recovered from filters. The fast rate of smoking (1 puff per 30 sec) appeared to be related to a greater number of puffs, shorter smoking times, and higher estimated doses of nicotine, while opposite trends were observed at the slow rate (1 puff per 60 sec). The time of day was found to be related to various parameters, especially the rate of smoking and its effects on nicotine intake occurring during the afternoon. Self-rated higher "activation" scores were reported during the afternoon. Increases in heart rate were found to be dependent on the drug intake. Consistent decreases in skin temperature were observed during the smoking period. The usefulness of this variable as an index of nicotine-induced vasoconstriction is discussed. Further research on the influence of circadian rhythms on smoking behavior and mood is suggested.

ANDERSON J M, BROWN C W 327
 A STUDY OF THE EFFECTS OF SMOKING UPON GRIP STRENGTH AND
 RECUPERATION FROM MUSCULAR FATIGUE
 RESEARCH QUARTERLY 22:102-108, 1951

The effects of cigarette smoking upon grip strength and recuperation from local muscular fatigue were studied in 14 men. Grip strength was measured by having the subjects (all right-handed) squeeze a dynamometer with the left hand. Seven took the smoking test first, and seven took the nonsmoking test first. A comparison of the group mean percentages of decrease in grip strength during smoking and nonsmoking tests showed that smoking one cigarette had no effect upon grip strength and recuperation from local fatigue of the flexors of the hand within the time period used. When the data obtained during the first and second tests were compared, higher group mean grip scores were found for the second test, indicating a slight effect of familiarization throughout the test.

ANDERSSON K 424
 EFFECTS OF CIGARETTE SMOKING ON LEARNING AND RETENTION
 PSYCHOPHARMACOLOGIA (BERLIN) 41:1-5, 1975

The effect of cigarette smoking (1 unfiltered, 2.1-mg nicotine cigarette) on arousal and correct responding in a rote nonsense syllable learning task was compared to a nonsmoking condition in male habitual smokers (n = 10). During the smoking condition, there was a decrease in the number of correct responses on the learning task. Heart rate increase following smoking coincided with the impaired learning performance and served as an indirect measure of physiological arousal. Long-term retention of learning was assessed by a delayed retention test 45 minutes following the end of the learning period (after the arousal level returned to presmoking values) and was found to be better in the smoking condition. These results support E. L. Walker's postulated relationship between increased arousal level, decreased short-term availability of the memory trace, and increased long-term consolidation of the memory trace.

ANDERSSON K, HOCKEY G R J 545
 EFFECT OF CIGARETTE SMOKING ON THE INCIDENTAL MEMORY
 PSYCHOPHARMACOLOGY 52:223-226, 1977

The effects of cigarette smoking on an immediate memory task were studied in 2 groups of 25 female students (19-39 years old, 46-75 kg, habitual smokers, 4-25 cigarettes/day) tested either after 7 min smoking period (1 cgt, Virginia King filter, 2.3 mg nicotine) or after a rest period with no smoking. The memory task, requiring immediate serial recall of 8 words showed no differences between smoking and nonsmoking groups. For incidental recall (position of words on the screen in any of 4 corners), the nonsmoking group was far superior to the smoking group. Heart rate increased after smoking while almost no change in heart rate occurred in the nonsmoking group. The incidental learning memory data suggest that smoking decreases subjects' attention to irrelevant information. These results agree with results obtained with noise-induced arousal and with the view that attentional selectivity is greater during increased arousal.

ANDERSSON K, HOLLSTEDT C, MYRSTEN A L, NERI A 351
 THE INFLUENCE OF TOBACCO SMOKING DURING THE ACUTE-ALCOHOL STAGE
 AND POST-ALCOHOL STAGE
 DTIC TECHNICAL REPORT NO. AD/B006771

The purpose of this study was to examine the influence of cigarette smoking on activation, performance, and mood during acute alcohol intoxication and in the post-alcohol stage. During

acute intoxication, epinephrine excretion and heart rate were increased, standing steadiness and hand steadiness were decreased, and performance on a choice reaction test and an arithmetic test was better with smoking than without smoking. During the post-alcohol stage (11-17 hours after drinking), systolic pressure was decreased, standing steadiness and hand steadiness were better, and arithmetic performance was worse with smoking than without smoking. Thus, cigarette smoking in combination with alcohol intake produced increased physiological arousal and more impairment in motor functions but counteracted alcohol-induced impairment of reaction time and mental performance in the acute alcohol stage.

ANDERSON W, BRIGHT M, LANE E, AVERITT J 822
ACUTE EFFECTS OF VARYING CIGARETTE COMPOSITION ON AIRWAY FUNCTION
CHEST 70(3):419, 1976

Puff profiles and butt analysis studies were conducted on 36 chronic cigarette smokers to determine the effects of varying cigarette composition on airway function. There were smokers who smoked a high-tar and nicotine cigarette, low-tar and nicotine cigarettes and who did not smoke. Airway studies were done before, 5, and 15 minutes after smoking. Smoking the low-tar and nicotine cigarette did not cause any measurable alteration of airway function in comparison to the control group, nor in comparison to pre-smoking levels. The high-tar and nicotine did cause a decrease in small airway function; no such effect was demonstrated for the low tar-nicotine product. Smoking one cigarette did not affect large airway function.

ANDERSSON K, POST B 100
EFFECTS OF CIGARETTE SMOKING ON VERBAL ROTE LEARNING AND
PHYSIOLOGICAL AROUSAL
SCANDINAVIAN JOURNAL PSYCHOLOGY 15:263-267, 1974

Subjects were moderate smokers who learned 2 lists of 7 nonsense syllables. Each smoked nicotine and nicotine-free cigarettes. The mean number of correctly anticipated syllables decreased after the first nicotine cigarette compared with the first nicotine-free cigarette. After the second nicotine cigarette, there was reversal of the previous response. Mean number of correctly anticipated syllables increased from 0 to 22 (out of 30) syllables in 30 trials compared to nicotine-free cigarettes. Epinephrine increased significantly during learning in both conditions. Mean HR increased after 1 nicotine cigarette from 70 to 85 bpm. Diuresis increased from 0.6 to 0.9 ml/min after smoking both types of cigarettes (nicotine and nicotine-free).

ANDREASSI J L 353
 EVOKED CORTICAL POTENTIALS AND INFORMATION PROCESSING
 DTIC TECHNICAL REPORT NO. AD/A002444, 1974

In this report on five experiments, whether smoking changes the visual evoked potential (VEP) and improved perceptual span for digits was investigated. Eight smokers and eight nonsmokers were tested after smoking and after sham smoking. Analysis of latency and amplitude of VEP components showed only that N2 latencies were shorter after smoking than after sham smoking. Performance on digit span was similar under the two conditions. The results were the same for smokers and nonsmokers. The results indicate that researchers studying the VEP should control smoking of their subjects prior to laboratory testing.

ARONOW WS, CASSIDY J 40
 EFFECT OF SMOKING MARIJUANA AND A HIGH NICOTINE CIGARETTE ON
 ANGINA PECTORIS
 CLINICAL PHARMACOLOGY AND THERAPEUTICS 17(5): 549-554, 1974

Male subjects ($n = 10$, 49.6 ± 5.8 years old) had classic stable exertional angina pectoris and severe coronary artery disease. Subjects exercised on a bicycle ergometer until onset of angina. After smoking 1 high-nicotine cigarette, mean heart rate increased from 73.8 to 89.4 beats/min; mean systolic BP increased from 120.6 to 135.3 mm Hg; mean diastolic BP increased from 79.7 to 88.6 mm Hg; and venous COHb was 3.05%. Mean exercise time until angina decreased from 243.4 ± 46.6 sec (controls) to 185.3 ± 43.5 sec (experimentals) after smoking 1 high-nicotine cigarette. There was a greater decrease in exercise time until angina after smoking 1 marijuana than after smoking 1 high-nicotine cigarette. No difference in S-T segment depression after exercise-induced angina after smoking a high-nicotine cigarette was observed.

ARONOW W S, CASSIDY J, VANGROW J S, MARCH H, KERN J C,
 GOLDSMITH J R 323
 EFFECT OF CIGARETTE SMOKING AND BREATHING CARBON MONOXIDE ON
 CARDIOVASCULAR HEMODYNAMICS IN ANGINAL PATIENTS
 CIRCULATION 50:340-347, 1974

The effect on cardiovascular hemodynamics of high-nicotine cigarettes and of breathing sufficient carbon monoxide (CO) to raise the coronary sinus carboxyhemoglobin level to that occurring after smoking 3 cigarettes was evaluated in 8 anginal

patients with coronary heart disease. Right and left heart cardiac catheterizations were performed. Smoking high-nicotine cigarettes caused increase in systolic and diastolic arterial pressure, heart rate, left ventricular end-diastolic arterial pressure, coronary sinus, arterial, and venous CO levels, a significant decrease in stroke index and coronary sinus, arterial, and venous PO₂ levels. Inhaling CO caused increases in left ventricular end-diastolic pressure and coronary sinus, arterial, and venous CO levels, and decreases in left ventricular dp/dt, stroke index, cardiac index, and coronary sinus, arterial, and venous PO₂ levels. Nicotine caused the negative inotropic effect, which increased the left ventricular end-diastolic pressure and decreased the stroke index after smoking.

ARONOW W S, SWANSON A J 714
THE EFFECT OF LOW-NICOTINE CIGARETTES ON ANGINA PECTORIS
ANNALS OF INTERNAL MEDICINE, 71:599-601, 1969

Ten men, all smokers, who had a history of exertional angina pectoris were studied to determine if smoking a low-nicotine cigarette affected this condition. Subjects exercised to a load of 60 w on a bicycle ergometer until the onset of angina pectoris. Exercise was performed four times in a nonsmoking state and four times after smoking a low-nicotine filter cigarette. All patients developed angina sooner if they smoked before exercising. All patients showed indications of an increase in myocardial oxygen consumption. Results suggest that patients show indications of an increase in myocardial oxygen consumption. Results suggest that patients with diseased coronary arteries who exercise after smoking even low-nicotine cigarettes may not be able to meet the increased demand for myocardial oxygen and may therefore develop angina pectoris sooner.

ASHTON H, MARSH V R, ET AL. 56
BIPHASIC DOSE-RELATED RESPONSES OF THE CNV (CONTINGENT NEGATIVE VARIATION) TO I.V. NICOTINE
BRITISH JOURNAL OF CLINICAL PHARMACOLOGY, 10:579-589, 1980

The effects of i.v. injections of nicotine bitartrate on the magnitude of the CNV were studied in male volunteers (n = 12). In three subjects, nicotine (500 or 750 ug) produced an increase in magnitude of C.V. In two subjects, nicotine (750 ug) produced a decrease in magnitude of CNV. The direction and magnitude of CNV changes were reproduced by cigarette smoking. In eight subjects, dose-response relationships for the effect of nicotine on the CNV were measured for doses of 12.5-800 ug. Individual and mean dose-response curves were biphasic; smaller doses produced an increase in CNV (stimulant effect) and larger doses produced a decrease in CNV (depressant effect). The results suggest that the biphasic effect of nicotine on the CNV reflects its ability to produce central stimulant and depressant effects.

ASHTON H, MILLMAN J E, TELFORD R, THOMPSON J W 585
 THE EFFECT OF CAFFEINE, NITRAZEPAM AND CIGARETTE SMOKING ON THE
 CONTINGENT NEGATIVE VARIATION IN MAN
 ELECTROENCEPHALOGRAPHY AND CLINICAL NEUROPHYSIOLOGY 337:59-71,
 1974

This study investigated the effects of cigarette smoking, caffeine and nitrazepam on the contingent negative variation (CNV). In Part I, 22 smokers were studied before, during and after smoking. In Part II, 12 subjects took nitrazepam, 13 took caffeine, 3 took a placebo, and 7 smoked. Part I results showed that smoking was associated with significant changes in CNV magnitude, the direction of change depending on the individual. Sham smoking produced no such changes. Reaction time and CNV magnitude were negatively correlated. Analysis of personality and rate of nicotine intake suggested that extroverted smokers had a slower intake rate than introverted smokers and had larger CNVs upon smoking. Extroverts had a stimulant effect whereas introverts had a depressant effect. In Part II, nitrazepam produced a fall in CNV magnitude and in amplitude of the N1-P2 component of the visual evoked response, and caffeine produced rises in these measures. Smoking produced changes in the CNV as in Part I. Heart rate and systolic blood pressure increased after smoking. It is suggested that the known dual action of nicotine is responsible for the effects of smoking on the CNV.

ASHTON H, STEPNEY R, THOMPSON J W 586
 SELF-TITRATION BY CIGARETTE SMOKERS
 BRITISH MEDICAL JOURNAL 2:357-360, 1979

This study examined whether smokers adjust their nicotine intake to some habitual level when smoking cigarettes of different strengths. Over the course of 11 weeks, 12 subjects smoked high-nicotine and low-nicotine cigarettes after an initial period of smoking their usual medium-nicotine cigarettes. The changes in plasma nicotine and blood carboxyhemoglobin concentrations showed that smokers compensated for about two-thirds of the difference in yields when switched to high- or low-nicotine cigarettes. Butt nicotine content and urine nicotine concentrations showed a similar pattern. Changes in puffing behavior and cigarette consumption were slight. The results show clear evidence of both upward and downward self-titration of nicotine and carbon monoxide intake when smokers change to cigarettes with different yields.

ASHTON H, MILLMAN J E, TELFORD R, THOMPSON J W 553
 STIMULANT AND DEPRESSANT EFFECTS OF CIGARETTE SMOKING ON BRAIN
 ACTIVITY OF MAN
 BRITISH JOURNAL PHARMACOLOGY 48:715-719, 1973

The CNV warning signal was a weak, momentary flash of light (0.3 joules; <100 ms); the imperative signal was a weak tone (frequency 500 Hz) presented 1.25 sec later. The subject was required to press a button as soon as possible after onset of the tone, which provided a reaction time recorded on a digital counter. The paired warning and imperative signals were presented to the subject at random intervals (4-8 sec) in series of 10, each series lasting 1 min 10 sec. Smoking changed the magnitude of the CNV, which was decreased in some subjects and increased in others. The decrease in CNV occurred in 11 of 22 subjects, the increase in CNV in 7 subjects; and 4 subjects were biphasic. Increases in CNV magnitude represent stimulant effects and decreases represent depressant effects.

ASHTON H, MILLMAN J E, RAWLINS M D, TELFORD R, THOMPSON J W 309
 THE USE OF EVENT-RELATED SLOW POTENTIALS OF THE BRAIN IN THE
 ANALYSIS OF EFFECTS OF CIGARETTE SMOKING AND NICOTINE IN HUMANS
 INTERNATIONAL WORKSHOP BEHAVIOR 26-37, 1978

Several experiments were conducted to determine the effect of cigarette smoking and nicotine on the contingent negative variation (CNV), an electroencephalographic phenomenon hypothesized as a measure of alertness. When 22 smokers smoked in their usual way, they showed significant change in the CNV. Extroverted subjects took smaller doses of nicotine per minute that produced increases in CNV magnitude; introverted subjects took larger doses and exhibited decreased CNV magnitude. When some of the same subjects received two intravenous infusions of 750 mg each, the CNV rose for some and fell for others. In a third experiment, six subjects received various intravenous doses of nicotine ranging from 18.5 to 800 ug. The dose-response curves were biphasic; at lower doses CNV magnitude increased as dose increased, but thereafter dose increases reduced the CNV. These studies show that cigarette smoking and nicotine produce similar changes in the CNV, and the direction of this effect relates to personality and dose. Nicotine can produce either a stimulant or depressant effect, and smokers may adjust their puffing rate to achieve the desired effect.

ASHTON H, SAVAGE R D, TELFORD R, THOMPSON J W, WATSON D W 546
 THE EFFECT OF CIGARETTE SMOKING ON THE RESPONSE TO STRESS IN A
 DRIVING SIMULATOR
 BRITISH JOURNAL PHARMACOLOGY 45:546-556, 1972

The present study compared behavioral and physiological responses of cigarette smokers and nonsmokers exposed to varying degrees of stress produced under controlled laboratory conditions. During the first half of the test while smokers were smoking, shorter reaction times in some instances among smokers coupled with the tendency for smokers to anticipate signals more than nonsmokers indicates the possibility that smoking has a stimulating or alerting effect. Lack of difference in performance between smokers and nonsmokers in the simpler and less stressful pursuit rotor and reaction times tests indicates that the effects of smoking are subtle and may be more important in complex situations associated with higher degrees of stress. No difference in performance was reported between high and low nicotine cigarette smokers. Of the physiological measurements, only heart rate showed differences between smokers and nonsmokers. Results of the Cattell Sixteen Personality Factor Questionnaire showed that smokers were more extroverted and more self-reliant than nonsmokers, but did not differ in other personality characteristics.

ASHTON H, STEPNEY R, THOMPSON J W 586
 SELF-TITRATION BY CIGARETTE SMOKERS
 BRITISH MEDICAL JOURNAL, 2:357-360, 1979

This study examined whether smokers adjust their nicotine intake to some habitual level when smoking cigarettes of different strengths. The changes in plasma nicotine and blood carboxyhemoglobin concentrations showed that smokers compensated for about two-thirds of the difference in yields when switched to high- or low-nicotine cigarettes. Butt nicotine content and urine nicotine concentrations showed a similar pattern. Changes in puffing behavior and cigarette consumption were slight. The results show clear evidence of both upward and downward self-titration of nicotine and carbon monoxide intake when smokers change to cigarettes with different yields.

ATTIA H, BAKIR M, ABDEL RAHMAN H
TOBACCO IN RELATION TO GLAUCOMA

59

BULLETIN OPHTHALMOLOGICAL SOCIETY EGYPT 71(75):37-42, 1978

Of 100 cigarette smokers with chronic simple glaucoma (65 males, 35 females; 40-55 years of age), 25 were asked to stop smoking cigarettes for 1 month. Under medical treatment with pilocarpine (2%-3%), the IOP was measured to be 22-32 mm Hg. In 10 cases of the 25 glaucoma patients who stopped smoking, the IOP decreased between 2-7 mm Hg, reaching a maximum of 25 mm Hg. There was no change in visual acuity nor in the central field changes. In the remaining 90 cases (75 continued smoking, 15 of the 25 patients stopped smoking), there were no changes in the IOP visual acuity or central field changes. Prohibiting cigarette smoking in glaucomatous patients leads to decreased IOP in 40% of cases varying between 2-7 mm Hg without changing the dose or frequency of pilocarpine drops. The most important factors which increase IOP among cigarette smokers are increased blood volume in the uvea and retina, contraction of the rectimuscles, vasodilatation within the iris and ciliary body, and arteriosclerotic changes.

AZIZ M, FAHMY K, EL-MASRY A

34

URINARY CATECHOLAMINES IN HABITUAL SMOKERS AND NONSMOKERS

ACTA PHYSIOLOGICA ACADEMICA SCIENCES HUNGARICAE 52(4):429-433, 1978

These experiments revealed the excitatory effect of cigarette smoking on the activity of sympathetic ganglion cells. Pesting urinary level of total catecholamines was slightly higher in the smoker group than in the nonsmoker group. Subjects in the non-smoker group (n = 25) had never smoked a cigarette; all were virotensive. Of the habitual smokers (n = 29), 20 were virotensive and 10 were hypertensive. The standard 2-cigarette smoking test was carried out. Free catecholamines were estimated in the 24-hr urine on the fourth day of abstinence and on the fifth day after smoking of 20 cigarettes. Smoking 20 cigarettes increased urinary catecholamine output in all individuals. The increase was largest in hypertensive smokers, moderate in hyperreactive smokers and nonsmokers, and smallest in viroreactive smokers and nonsmokers. Smoking 2 cigarettes increased the number of hyper-reactors among hypertensives by 60% and the number of hyper-reactors among virotensives by about 20%. People who have highly sensitive adrenergic receptors are more liable to suffer hypertension if they smoke than people with less sensitive receptors.

BALLANTYNE D, DEVINE B L, FIFE R 671
 INTERRELATION OF AGE, OBESITY, CIGARETTE SMOKING AND BLOOD
 PRESSURE IN HYPERTENSIVE PATIENTS
 BRITISH MEDICAL JOURNAL 1:880-881, 1978

The relationships among age, obesity, cigarette smoking and blood pressure were investigated in 637 men and 835 women who attended a blood pressure clinic with untreated hypertension. The mean age, cigarette consumption, ponderal index, and recumbent systolic and diastolic blood pressures were calculated separately for smokers and nonsmokers as well as for men and women. In contrast to results of previous population studies, this study found no relation between cigarette consumption and blood pressure for men or women. In addition, only in nonsmoking men was there a relation between obesity and blood pressure. Age and blood pressure seemed to be more strongly related in men than in women.

BARGERON L M, SHMKE D, BONLUBOL F, CASTELLANOS A, SIEGEL A, BING R J 882
 EFFECT OF CIGARETTE SMOKING ON CORONARY BLOOD FLOW AND MYOCARDIAL METABOLISM
 CIRCULATION 15:251-257, 1957

The effects of cigarette smoking on coronary flow, myocardial use of oxygen, and myocardial extraction of glucose, pyruvate, lactate, and ketones were studied in 14 subjects without heart disease who underwent catheterization of the coronary sinus. Measurements taken before and during smoking showed that coronary blood flow increased significantly, coronary vascular resistance fell significantly, and myocardial usage was not significantly changed. Glucose extraction fell significantly but extraction of pyruvate and ketones did not change significantly.

BARLOW D H, BAER D J 676
 EFFECT OF CIGARETTE SMOKING ON THE CRITICAL FLICKER FREQUENCY OF HEAVY AND LIGHT SMOKERS
 PERCEPTUAL AND MOTOR SKILLS 24:151-155, 1967

Changes in the critical flicker frequency threshold of heavy and light smokers after smoking a cigarette were compared with changes in smokers who did not smoke a cigarette. Thresholds were determined 5 and 1 min before and 1, 5, 10 and 15 min after 10 inhalations of a cigarette. Immediately after smoking both groups showed an increase in critical flicker frequency which gradually returned to presmoking levels for light smokers but

fell below for heavy smokers before rising to presmoking levels. Thus, it seems that the biphasic effect of nicotine on central nervous system functioning is only evidenced in heavy smokers.

BATSON H W 862
THE EFFECTS OF CIGARETTE-WITHDRAWAL AND A RELATED VERBAL STIMULUS
ON REM SLEEP AND DREAMING
DISSERTATION ABSTRACTS INTERNATIONAL 41(4-B):149-B, 1980

The effects of cigarette-withdrawal (or thirst) and a verbally related stimulus on dream reports were investigated. After baseline dreams were elicited from subjects, subjects were cigarette-deprived for 24 hr and during their laboratory sleep period; a cigarette-related message was delivered during REMP (Phasic and Tonic). Cigarette content in dreams was not maximized in the cigarette withdrawal condition beyond the level of the control situation. Cigarette-related dream content was more frequent in the cigarette-withdrawal-tonic stimulus than in the cigarette-withdrawal-tonic-no-stimulus condition. Class 2 minimum hostility was more frequent in the cigarette-withdrawal than the fluid-deprivation condition. Cigarette withdrawal did not increase the frequency of oral-derivative dream themes. Dream themes seemed to have bearing on intensity of post-sleep cigarette need; subjects with gratifying dreams (positive themes of eating, drinking, or cigarette withdrawal symptoms) smoked fewer cigarettes following sleep than non-gratified subjects. Cigarette-withdrawal in the presence of auditory stimulus increased the amount of REM phasic activity. There seemed to be more words in the cigarette-withdrawal-phasic-stimulus than in the no-stimulus counterpart. Moreover, there were more words from phasic than tonic dreams. It is suggested that deprivation procedures served as an excitatory process, which became bound by subjects' screening mechanisms and resulted in less cigarette-related dreams than control conditions.

BKHEIT S, FLETCHER E 71
THE EFFECTS OF SMOKING ON MYOCARDIAL CONDUCTION IN THE HUMAN
HEART
AMERICAN HEART JOURNAL 91:6, 712-720, 1976

The effects of smoking on myocardial conduction in the heart were studied with 28 smokers. Among those subjects with atrioventricular (A-V) conduction via the normal pathways, A-V nodal conduction time during sequential atrial pacing was shortened after a few puffs of a cigarette. Smoking abolished blocked beats in these subjects and in subjects with spontaneous Wenckebach block. Smoking did not affect conduction velocity in the anomalous pathways in the Wolff-Parkinson-White syndrome. Subjects with

atrial fibrillation showed increased ventricular rate after one to three puffs; smoking apparently antagonized the cholinergic effects of the digitalis these subjects were taking. Maximum values of urinary nicotine occurred one hour after completion of smoking. These values were higher than control values. These results indicate that smoking has a specific effect on A-V nodal conduction; minute amounts of absorbed nicotine apparently have an adrenergic stimulant effect.

BENOWITZ N L, JACOB P, JONES R T, ROSENBERG J 4
 INTERINDIVIDUAL VARIABILITY IN THE METABOLISM AND CARDIOVASCULAR
 EFFECTS OF NICOTINE IN MAN
 JOURNAL OF PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS
 221(2):368-372, 1982

This experiment studied interindividual differences in metabolic and renal clearance of nicotine and the relationship between cardiovascular effects and plasma concentration of nicotine. Interindividual differences in nicotine metabolism were substantial. Infusion of nicotine promptly increased heart rate, with a maximum rate reached within 5 or 10 minutes. After infusion, a given nicotine concentration had less effect on heart rate than during infusion. Sensitivity of heart rate to low concentrations of nicotine and rapid development of tolerance to higher concentration suggests that nicotine-mediated cardiac responses may not differ depending on how much nicotine a cigarette delivers. In contrast, skin temperature decreased gradually during infusion and showed no evidence of tolerance. Thus, nicotine-mediated vasoconstrictor responses may reflect the amount of nicotine consumed and the time course of persistence of nicotine in the body.

BENOWITZ N L, KUYT F, JACOB P 158
 INFLUENCE OF NICOTINE ON CARDIOVASCULAR AND HORMONAL EFFECTS OF
 CIGARETTE SMOKING
 CLINICAL PHARMACOLOGY THERAPEUTICS 36(1):74-81, 1984

Ten heavy smokers were studied (in 4 3-day treatment blocks) while smoking their own brand of cigarettes, smoking high-nicotine (HN) or low-nicotine (LN) research cigarettes, or abstaining. Cardiovascular effects were measured and urinary nicotine excretion was measured as a control. Blood nicotine concentrations were 4 times as high smoking HN as smoking LN cigarettes. Values while smoking the subjects' own brands were intermediate. Smoking increased mean (24-hr) heart rate (HR), but HR effect did not differ as a result of nicotine exposure. Blood pressures tended to be higher while smoking, but plasma

cortisol concentrations throughout the day did not differ while smoking or abstaining. Changing nicotine content per se may not alter the risk of sudden adverse cardiac events associated with cigarette smoking.

BETTMAN J W, FELLOWS V, CHAO P 493
THE EFFECT OF CIGARETTE SMOKING ON THE INTRAOCULAR CIRCULATION
ARCHIVES OF OPHTHALMOLOGY 59:481-488, 1958

The effect of cigarette smoking on retinal vessels was studied before and after smoking and after breathing pure oxygen, using fundus photographs examined under the dissecting microscope. After one-half or one full cigarette was smoked, 7 of the 72 points on the blood vessels showed vasoconstriction averaging 0.8 units, and two showed dilation. Ten minutes after the cigarette was smoked, only four of the points showed vasoconstriction, and two showed dilation. After inhalation of oxygen for 5 min, 26 of the 72 points (36%) showed vasoconstriction of an average of 1.0 unit. Of the 18 subjects, seven showed an increase of 10 mm of blood pressure or more after smoking, and 13 showed an increase of 20 mm or more. After oxygen inhalation, six showed a decrease of at least 10 mm, and none showed an increase. Then skin temperature in five subjects increased 1 degree or more after smoking and in others it decreased 1 degree or more. The skin temperature changes and blood pressure changes were not correlated. It is concluded that smoking constricts the retinal blood vessels in a few humans, changes them not at all in most, and may actually dilate them on rare occasions.

BLITZER P H, RIMM A A, GIEFER E E 237
THE EFFECT OF CESSATION OF SMOKING ON BODY WEIGHT IN 57,032
WOMEN: CROSS-SECTIONAL AND LONGITUDINAL ANALYSIS
JOURNAL OF CHRONIC DISEASES 30:415-429, 1977

A U-shape relationship was found between amount smoked and the obesity index (IC) among both current and former inhalers. Women who smoked moderately (11-30 cgts/day) had a low mean IC; women who smoked either more or less than this amount had a higher mean IC. Cross-sectional analysis of the effect that stopping smoking has on weight showed that former smokers (inhalers) were 3.8 lbs heavier than current inhalers and that former smokers (non-inhalers) were 3.2 lb heavier than current smokers (non-inhalers). All weight changes in this analysis were significant. The longitudinal analysis used lifetime obesity histories of 5 cohorts of 4,781 women born between 1910-1919. Weight gain after quitting smoking was increased among heavy smokers; 30 lbs for

inhalers smoking over 451 cgts/day as compared to 4 lbs for inhalers smoking 1-10 cgts/day. Older women (40-59 years old) indicated a larger weight gain than did younger women at every amount smoked and inhaler versus non-inhaler status. Larger weight gains were indicated among women who smoked heaviest (more than 41 cgts/day) prior to cessation.

BORNEMISZA P, SUCIU I

14

EFFECT OF CIGARETTE SMOKING ON THE BLOOD GLUCOSE LEVEL IN NORMALS AND DIABETICS

MED INTERNE 18(4):353-356, 1980

The effect of cigarette smoking on blood glucose level (BGL) was investigated in diabetic patients (n = 26) and normal controls (n = 24), all smokers. Using the ortho-tolidine method, blood glucose levels were determined before smoking and 15, 30, and 60 min after smoking two cigarettes. Both groups showed an increase in BGL following smoking, larger in the diabetics, however. In 16 cases, the experience was repeated once more, and an even higher increase of BGL was recorded. Conversely, no increase in BGL was noted after smoking nicotine-free cigarettes nor after smoking tobacco cigarettes without inhaling. The increase of BGL after smoking is assumed to be due to the mobilization of catecholamines and the stimulation of growth hormone STH and cortisol production. This reaction is greater in diabetics than in metabolically normal subjects.

BOSSE R, GARVEY A J, COSTA P T

234

PREDICTORS OF WEIGHT CHANGE FOLLOWING SMOKING CESSATION
INTERNATIONAL JOURNAL OF ADDICTIONS 15(7): 969-991, 1980

Smoking behavior and weight change over five years were studied for 1,749 men. Ex-smokers generally gained more weight than men in other smoker categories, yet nearly 36% of the ex-smokers either lost weight or maintained the same weight after quitting. Younger quitters tended to gain weight whereas older quitters tended to lose weight; lean men tended to gain weight whereas stout men tended to lose weight; subjects who had received high doses of tar tended to gain weight whereas those who consumed less tar tended to lose weight; subjects with low clinical anxiety tended to gain weight whereas those with high clinical anxiety tended to lose weight. The results concerning clinical anxiety may be spurious because the measure used was positively skewed. For smokers, only initial weight and age predicted weight change. This study does not support any of the psychosocial explanations of weight gain after quitting smoking. Other factors related to weight change must be identified before further theorizing is attempted.

BOYD G M, MALTZMAN I 853
 BILATERAL SKIN CONDUCTANCE AND THE EFFECTS OF NICOTINE
 PSYCHOPHYSIOLOGY 19(5):552, 1982

The effect of cigarette smoking on bilateral skin conductance was studied in eight smokers and eight nonsmokers to determine the relative activation of the cerebral hemispheres by nicotine. Smokers abstained from smoking for three hours before the experiment. Bilateral magnitude measurements were taken of skin conductance during rest and following smoking a cigarette containing 1.1 mg nicotine. Results indicated that smokers had relatively larger spontaneous skin conductance magnitudes in their left hands when not smoking and larger skin conductance magnitudes in their right hands following smoking. Smokers did not differ significantly from controls in either condition. This skin conductance asymmetry is interpreted to indicate that the right hemisphere is activated more relative to the left hemisphere following smoking in smokers. Auditory tasks were given to differentially activate the cerebral hemispheres. While non-smokers demonstrated task-appropriate changes in skin conductance magnitude asymmetry (i.e., larger magnitudes in the right hand during right hemisphere activation), smokers did not demonstrate any similar interaction between task and hand. It is suggested that the tonic effect of cigarette smoking on hemisphere activation overrides the phasic fluctuations in utilization that would normally occur during changing task demands.

BREIDENBACH S T, ARNOLD J L, HEIMSTRA N W 369
 THE EFFECT OF SMOKING ON TIME ESTIMATION PERFORMANCE
 DTIC TECHNICAL REPORT NO. AD/A047744, 1976

Effects of nicotine on the processing of visually presented material were determined in male subjects (N = 25, 18-25 years old) during the performance of 2 tasks. In the first task, there were differences (mean constant error) between smoking and smoking deprived subjects for the fastest speed, shortest viewing time combination and the slowest speed, longest viewing time combination. In both cases, smokers performed worse in post-treatment trials than in the baseline period prior to treatment, while deprived smokers maintained about the same level of performance or improved slightly. In the second task, although smoking and smoking deprived subjects differed only under certain speed and exposure time conditions, smokers performed better than deprived smokers. Smoker and smoker deprived subjects differed in the fastest speed, longest viewing time combination; the slowest speed, medium viewing time combination; and the slowest speed, longest viewing time combination. In velocity estimation tasks, the detrimental effects of nicotine are not present over the wide range of test conditions when objects are viewed cen-

trally or when the task to be performed involves higher levels of information processing. Results are in contrast with previous research in which the detrimental effects of nicotine were observed over a wide range of speed and concealment values when similar tasks were presented peripherally.

BROWN B B 484
 ADDITIONAL CHARACTERISTIC EEG DIFFERENCES BETWEEN SMOKERS AND NONSMOKERS
 SMOKING BEHAVIOR: MOTIVES AND INCENTIVES, DUNN W J, ED.,
 WASHINGTON DC, WINSTON & SONS, 1973, PP. 67-81

The purpose of this study was to investigate the relationship between different degrees of smoking activity and EEG patterns. Active smokers and former heavy smokers had higher frequency of alpha than other groups. Average and very heavy smokers had the most variable alpha frequency. Amplitude of alpha was larger for average smokers than for very heavy smokers. Heavy smokers had the most rhythmic beta activity, and smokers had greater amplitude of beta than nonsmokers and former smokers. Very heavy smokers had less beta and theta activity than other groups. Smokers and former smokers had more regularity of theta rhythm than nonsmokers. Active and former smokers had more identifiable frequencies than nonsmokers. Heavy and very heavy smokers tended to have different personality traits from nonsmokers. In general, the EEG characteristics of smokers correlated with characteristics of extroverts. The results suggest that heavy smokers continue the EEG maturation process to the extreme limits of fast, low-voltage, rhythmic activity. EEG patterns of nonsmokers resemble EEGs of rest and relaxation, whereas those of very heavy smokers resemble those of intense activation.

BROZEK J, KEYS A 235
 CHANGES IN BODY WEIGHT IN NORMAL MEN WHO STOP SMOKING CIGARETTES
 SCIENCE 125:1203, 1957

In a group of 300 normal business and professional men, weight changes were compared for those who continued to smoke and those who voluntarily chose to quit smoking cigarettes. At the outset, the control and test groups did not differ in age or weight. Average weights were calculated for years 1 and 2 (before test subjects stopped smoking) and for years 3 and 4 (after test subjects stopped smoking). A weight change of +1.18 kg was reported for the control group and of +5.65 kg for the group who quit smoking cigarettes. The weight change for subjects who quit smoking shows the effect on body weight of stopping cigarette smoking.

BRUNDIN T 356
EFFECTS OF TOBACCO SMOKING ON THE BLOOD TEMPERATURE DURING
EXERCISE
ACTA PHYSIOLOGY SCANDINAVIAN SUPPLEMENT 479:43-67, 1980

Thermal reactions to exercise programs of different duration were studied before and after smoking. Short-term exercise -- after smoking: the total exercise-induced temperature rise was almost 50% temperature before smoking. The arteriovenous difference AVD at rest decreased compared with the initial baseline measurement suggesting that cardiac output was increased by smoking. Exercise induced increase in AVD was greater after smoking. Carboxyhemoglobin in arterial blood increased 2% after smoking. Mean heart rate (HR) increased from 62 +/- 3 bpm to 116 +/- 10 bpm at 90W after first exercise period. $\dot{V}O_2$ after smoking increased. Pulmonary artery (PA) temperature increased during smoking and a higher steady state level was attained 6 min after onset of smoking. AVD increased 2-fold at 17 min of exercise but did not change smoking significantly. Cardiac output increased after smoking. HR abruptly increased after smoking. Increased HR after smoking was more pronounced than increased cardiac output; SV (stroke volume) was decreased in response to smoking. Carboxyhemoglobin increased 1%. Relative hyperthermia appeared during short-term exercise performed immediately after smoking. Temperature effect was paralleled by increased heat generation, reflected by an increase in total body oxygen consumption.

BUFF I E 891
EFFECT OF CIGARETTE SMOKING IN THE NORMAL PERSON
JOURNAL AMERICAN MEDICAL ASSOCIATION 157:569, 1955

The effect of cigarette smoking on the heart was studied in a group of 400 normal subjects by measurements on a ballistocardiograph. Only 42, or 10%, of the responses were abnormal. In the 20 to 30 age group, 5% of responses were abnormal and in the 30 to 40 year group, 15%. For those with abnormal responses after smoking, cessation of smoking is highly desirable.

BUIST A S, SEXTON G J, NAGY J M, ROSS B B 750
THE EFFECT OF SMOKING CESSATION AND MODIFICATION
ON LUNG FUNCTION
AMERICAN REVIEW RESPIRATORY DISEASE 114:115-122, 1976

The effect that stopping or modifying cigarette smoking on lung function and the time course of change were studied in 75 subjects divided into smoker, intermittent and quitter groups.

Subjects were tested before stopping smoking and at 1, 3, 6 and 12 months after initial testing with a respiratory symptom questionnaire, spirometry, closing volumes, and the slope of the alveolar plateau of the single-breath nitrogen test. In those who stopped smoking, improvement in closing volume as a percentage of vital capacity and closing capacity as a percentage of total lung capacity was found at 6 and 12 months and in the slope of the alveolar plateau at 1, 6, and 12 months. Respiratory symptoms decreased dramatically in those who stopped smoking, moderately in those who reduced consumption by at least 25%, and very little in those who did not modify consumption very much. Thus, smoking cessation improves respiratory symptoms and function. Decreasing consumption at least 25% improves symptoms but not function within 1 month with improvement up to 6 months after smoking cessation.

BURGESS J H, RAPAPORT E 806
CARDIORESPIRATORY EFFECTS OF NICOTINE INJECTED INTO THE HUMAN
ASCENDING AORTA
CANADIAN MEDICAL ASSOCIATION JOURNAL 98(2):1110, 1968

The cardiorespiratory effects of nicotine injected into the ascending aorta were studied by injecting 2.5 micrograms of nicotine into 25 cardiac patients. An immediate subjective response was found in 15 patients. There was no change in pulmonary arterial minus pulmonary wedge pressure and no change in cardiac or respiratory rate. Mean respiratory volume increased. There was also an increase in mean aortic pressure in the 15 patients having a subjective response to the injection. It is concluded that the physiological effects of small doses of nicotine are due to chemoreceptor stimulation, and that nicotine injected into the ascending aorta in doses large enough to produce a subjective response does not cause an increase in pulmonary vascular resistance.

BURN G P, GREWAL S 884
THE ANTIDIURETIC RESPONSE TO AND EXCRETION OF PITUITARY
(POSTERIOR LOBE) EXTRACT IN MAN WITH REFERENCE TO THE
ACTION OF NICOTINE
BRITISH JOURNAL PHARMACOLOGY 6:471-482, 1951

The antidiuretic action of nicotine was studied in 3 subjects who were injected with posterior lobe pituitary extract and nicotine hydrogen tartrate. The relation of pituitary extract dose to the time of peak inhibition of diuresis was calculated. Extract was not detected in urine when doses were 120 mU or less. Mean recovery was 5% for doses above 120 mU. When 2 cigarettes were smoked in one test, 95 mU of antidiuretic hormone was excreted.

Responses to nicotine injections of 0.8 to 2.7 mg base i.v. varied in different subjects. Observations indicate that smoking 2 cigarettes causes the release of a mean of 75 to 100 mU of antidiuretic hormone.

BURN J H, TRUELOVE L H, BURN I 562
THE ANTIDIURETIC ACTION OF NICOTINE AND OF SMOKING
BRITISH MEDICAL JOURNAL 403-406, 1945

Experiments have shown that nicotine inhibits diuresis in the rat, but this effect does not occur if the pituitary gland has been removed. With human subjects, six out of seven subjects experienced inhibition of diuresis for two to three hours after smoking one, two, or three cigarettes, dependent on individual sensitivity. An experiment with two subjects showed the same effect after intravenous injection of nicotine in an amount equal to the amount that produces the effect after smoking. Extract from the posterior lobe of the pituitary gland had an antidiuretic effect. These results indicate that nicotine stimulates the hypothalamus and causes discharge of antidiuretic hormone of the posterior lobe of the pituitary gland, and possibly other hormones as well.

BURSE R L, GOLDMAN R F, DANFORTH E, HORTON E S, SIMS E A H 354
EFFECTS OF CIGARETTE SMOKING ON BODY WEIGHT, ENERGY EXPENDITURE,
APPETITE, AND ENDOCRINE FUNCTION
DTIC TECHNICAL REPORT NO. AD/A114213, 1982

This study assessed the relative importance of changes in appetite, hormonal responses, plasma substrate concentrations, and metabolic rate as possible factors in weight gain after stopping smoking. Only small, insignificant changes in weight occurred during the study. During walking exercise in the non-smoking period, heart rate was lower than during the smoking periods. There were no changes in resting or walking metabolic rate, but appetite ratings nearly doubled during the nonsmoking period. The response of thyroid stimulating hormone (TSH), but not of prolactin, to thyrotropin-releasing hormone was suppressed during the smoking periods, which may reflect a central effect of smoking. Changes in concentrations of TSH, thyroxine, and triiodothyronine were not significant but raised the possibility of a slight increase in thyroid activity during periods of smoking. The most potent mechanism for promoting weight gain after stopping smoking appears to be the release of appetite from suppression.

CALISSENDORFF B 72
 EFFECTS OF REPEATED SMOKING ON DARK ADAPTATION
 ACTA OPHTHALMOLOGICA 55:261-268, 1977

The effect of cigarette smoking upon dark adaptation was studied in 12 subjects using an automatic adaptometer. Two series (A and B) of experiments comprising 3 trials over a duration of 20 min each were performed. Series A served as nonsmoking control; series B included smoking of 2 cigarettes. Comparing each trial from series A with respective trial from series B, no differences were found. In series A, there was improvement in dark adaptation in the second trial compared with the first, and further improvement in the third trial compared with the second. In series B, the third trial showed improvement compared with the first, and further improvement in the third trial compared with the second. In series B, the third trial showed improvement compared with the first trial, but impairment compared with the second trial. Differences in calculated deviations between first and third trials showed that dark adaptation after smoking was deteriorated compared with controls. The mesopic range (the intermediate stage in which activities of cones and rods overlap) is most affected by smoking. The effects of smoking are more complicated and contradictory than those of pure nicotine or carbon dioxide.

CARRUTHERS M 683
 MODIFICATION OF THE NOREPINEPHRINE RELATED EFFECTS OF SMOKING
 BY BETA-BLOCKADE
 PSYCHOLOGICAL MEDICINE 6:251-256, 1976

The cardiovascular and biochemical responses to smoking and their modification by beta-blockage were studied by observations of changes in norepinephrine-related effects. Plasma norepinephrine increased in 12 subjects during smoking of a cigarette. Heart rate, blood pressure, and plasma free fatty acids increased with smoking but beta-blockade with oxprenolol prevented this rise. No subjective differences in the pleasure of smoking were noted by subjects when taking a placebo or oxprenolol although most rated the low-nicotine brand too mild to be satisfying. This supports the view that the pleasures of smoking are mainly due to direct stimulation of the central nervous system which appears unaffected by beta-blockade.

CARTER G L 547
 EFFECTS OF CIGARETTE SMOKING ON LEARNING
 PERCEPTUAL AND MOTOR SKILLS 39:1344-1346, 1974

Each subject was required to take two separate letter-digit substitution tests of 20 trials. Subjects also took a serial-learning test of 12 nonsense syllables twice. These syllables

had a Glaze (1928) scale value of 47% and were of intermediate difficulty as measured by the same scale. Four testing sessions were required, as each task was presented separately. Although there was a difference between the 10 smoking subjects and the 10 nonsmoking subjects on number correct on a letter-digit substitution task for the second of two 10-trial blocks given in the first of two sessions (seven days apart), there was no difference in savings (number of trials) for serial learning. Data for both second sessions seem to substantiate that there was no difference in the learning of the youthful smokers and nonsmokers when the former were not smoking.

CELLINA G U, HONOUR A J, LITTLER W A 491
DIRECT ARTERIAL PRESSURE HEART RATE AND ELECTROCARDIOGRAM
DURING CIGARETTE SMOKING IN UNRESTRICTED PATIENTS
AMERICAN HEART JOURNAL 89(1): 18-25, 1975

A 24-hour continuous reading of arterial pressure, heart rate, and electrocardiogram (ECG) was taken in 9 regular smokers who were free to do as they pleased during the experiment. There was an increase in arterial pressure five minutes after smoking a cigarette. The systolic rise in pressure (mean 10.7 mm Hg) was twice that of the diastolic rise (5.3 mm Hg) and was present under different conditions of everyday life with the exception of lying in bed before sleep. No quantitative differences were found between normotensive and hypertensive subjects. There was no certain change in heart rate (mean increase +0.3 beats/minute) in the group as a whole. Smoking caused a short-term fall in arterial pressure and heart rate occurring over 8 to 10 heart beats immediately after the first inhalation of tobacco smoke, followed by a rebound rise in arterial pressure to a level greater than the presmoking level. Cigarette smoking caused angina pectoris in one subject and showed ST-segment depression preceding the subjective appreciation of pain. No significant change in ECG was found in the other patients.

CHEREK D R 108
EFFECTS OF SMOKING DIFFERENT DOSES OF NICOTINE ON HUMAN
AGGRESSIVE BEHAVIOR
PSYCHOPHARMACOLOGY 75:339-345, 1981

The aggressive and nonaggressive responding of eight smokers was tested after not smoking, smoking low-nicotine cigarettes, and smoking high-nicotine cigarettes. There were two possible aggressive responses: subtracting money from or administering a blast of white noise to a fictitious person. The former response was considered more aggressive. Aggressive responding was provoked by subtracting money from the subjects. The nonaggressive response resulted in the subject's accumulating money. Smoking

produced dose-dependent decreases in both types of aggressive responses under conditions of both low and high provocation. The more aggressive option was more sensitive to the effects of smoking. Smoking also increased nonaggressive responding, indicating that the suppressant effect of nicotine was not due to a nonspecific depressant action. It is possible that the results for the nonsmoking condition reflect the effects of withdrawal from smoking, but studies with nonsmokers would be needed to address this point.

CHEREK D R 179
EFFECTS OF CIGARETTE SMOKING ON HUMAN AGGRESSIVE BEHAVIOR
IN: BIOLOGICAL PERSPECTIVES ON AGGRESSION
NEW YORK, A R LISS, INC 1984, pp. 333-344

Subjects either did not smoke or smoked 2 experimental cigarettes. Smoking of the first cigarette was initiated 30 min and the second cigarette 8 min prior to beginning a 60 min experimental session. Subjects were required to take 15 puffs at rate of 1 puff/30 sec. Two aggressive behaviors were studied: 1. the subtraction of money from another person was considered the more aggressive response option; 2. the delivery of a blast of noise was considered the less aggressive response option. Smoking high-dose nicotine cigarettes produced more suppression of aggressive behavior than the low-dose nicotine cigarette. The same doses of nicotine which suppressed aggressive responses increased nonaggressive responses.

CHEREK D R, SMITH J E, LANE J D, BRAUCHI J T 838
EFFECTS OF CIGARETTES ON SALIVA CORTISOL LEVELS
CLINICAL PHARMACOLOGY THERAPEUTICS 32(6):765-768, 1982

The effects of no smoking and smoking on saliva and plasma cortisol levels were examined during a reinforced operant responding task. The operant task had the effect of increasing the number of cigarettes smoked, the number of puffs, and the total puff duration in all subjects. The effect of this increased smoking on cortisol levels was also examined. Results indicated a decline of cortisol levels from the beginning to the end of sessions. End-of-session saliva cortisol levels were not affected by any of the conditions. Plasma cortisol levels correlated highly with saliva cortisol levels. It is concluded that these results are opposite those of other studies on smoking effects on cortisol. Consequently, the hypothesized role of cortisol release in heart disease is not supported. Since beta-endorphin release in the central nervous system has been linked to cortisol release, the results of this study do not support the hypothesized role of a beta-endorphin reward mechanism in maintaining tobacco smoking.

CHIANG S T, WANG B C

575

ACUTE EFFECTS OF CIGARETTE SMOKING ON PULMONARY FUNCTION
 AMERICAN REVIEW RESPIRATORY DISEASE 101:860-868, 1970

The effect of acute cigarette smoke inhalation on pulmonary function was studied in seven non-smoking 18-43 yr old males. Among the lung volume measures, only an increase of residual volume was different between the control and smoking conditions. None of the respiratory flow measures was different between the two conditions. There were no significant differences in all but one (nitrogen clearance delay) of the nitrogen wash-out measures. The differences between the two conditions included nitrogen washout time, lung clearance index, fractional volume of slow compartment, and alveolar dilution factor of whole system. It is concluded that the conventional multiple breath nitrogen washout technique is more sensitive than the spirometric technique for detecting mild bronchial constriction following smoke inhalation. Furthermore, since this study indicates that cigarette smoke inhalation causes acute changes in pulmonary function, it is recommended that smokers abstain from smoking at least one hour before pulmonary function tests for early detection of obstructive airway disease.

CLARK M S G, RAND M J

128

EFFECT OF TOBACCO SMOKE ON THE KNEE-JERK REFLEX IN MAN
 EUROPEAN JOURNAL OF PHARMACOLOGY 3(4):294-302, 1968

The role of nicotine in decreasing the knee-jerk reflex was investigated among smoking and nonsmoking students. The reflex was elicited automatically every 10 seconds in the subjects, while they also performed a distracting motor task. Cigarette smoking caused a more pronounced decrease in the knee-jerk in nonsmokers and light smokers than in heavy smokers. Smoking cigarettes with a 2.1% nicotine content inhibited the reflex in an increased number of subjects than did smoking the low-nicotine (0.1%) cigarettes. The knee-jerk of some subjects was facilitated by the distracting task. It is suggested that the decrease of the knee-jerk is due to the nicotine in the cigarette smoke and that the tranquilization effects of smoking may be related to inhibition of reflex mechanisms.

CLARKE B G, GUYATT A R, ALPERS J H, FLETCHER C M, HILL I D

569

CHANGES IN AIRWAYS CONDUCTANCE ON SMOKING A CIGARETTE
 THORAX 25:418-422, 1970

Using a body plethysmograph, airways conductance of 25 smokers was measured before and after smoking an unfiltered cigarette on each of four days and before and after a control period on one

day. The change in conductance after smoking was larger than the change after not smoking. The variance in conductance was as great as that in a previous study in industry. The close supervision and stable environment in this study did not produce more uniform measures, indicating that the variation may be due to random fluctuation. In a second study, the bronchoconstrictor effect of three different cigarettes was compared for 16 subjects. The unfiltered cigarette produced a greater effect than either of the filtered cigarettes, but there was no difference between the response to the cigarette with a filter that removed vapor and the response to the cigarette with a filter that removed particles.

COIRO V, D'AMATO L, CORCIANI E, ROSSI G 852
NICOTINE FROM CIGARETTE SMOKING ENHANCES CLONIDINE-INDUCED
INCREASE OF SERUM GROWTH HORMONE CONCENTRATIONS IN MEN
BRITISH JOURNAL CLINICAL PHARMACOLOGY 18:802-805, 1984

To test the hypothesis that nicotine may stimulate the secretion of growth hormone by interaction with an adrenergic pathway, serum levels of growth hormone were studied following smoking and the oral administration of clonidine (0.15 mg), a specific alpha-adrenergic stimulant. Sixteen normal males (24-37 yrs old) who were chronic smokers abstained from smoking for 12 hours before receiving the single dose of clonidine. The subjects then smoked two non-filter cigarettes within 15 minutes of clonidine administration. Blood samples were taken at five 30-min intervals following drug administration. Results indicated that nicotine induced an increase in serum growth hormone within 30 min of smoking. Clonidine increased growth hormone levels. Together, nicotine and clonidine increased growth hormone levels higher than after either smoking- or clonidine-induced increments alone. These results suggest that growth hormone secretion in man may be mediated by a neuroendocrine pathway that is sensitive to both nicotinic cholinergic and adrenergic stimulation.

COFFMAN J D 833
EFFECT OF PROPRANOLOL ON BLOOD PRESSURE AND SKIN BLOODFLOW DURING
CIGARETTE SMOKING
JOURNAL OF CLINICAL PHARMACOLOGY 9(1):39-44, 1968

The effect of propranolol on the increase in arterial blood pressure and cutaneous vascular resistance caused by smoking and nicotine was investigated in 13 normal smokers. Subjects either

smoked two cigarettes or received 4 mg of nicotine intravenously. Ten minutes later, they received 10 mg of propranolol intravenously. Subsequently, the subjects smoked or were administered nicotine. Both smoking and nicotine increased foot vascular resistance and blood pressure in control studies after propranolol. There was no significant difference in the changes observed with or without propranolol. Propranolol attenuated or prevented the increase in heart rate seen during smoking and intravenous nicotine. It is concluded that patients treated with propranolol will not show excessive increase in blood pressure or cutaneous vascular resistance during cigarette smoking and that the increase in heart rate will be prevented or attenuated.

COHEN S I, PERKINS N M, URY H K, GOLDSMITH J R
CARBON MONOXIDE UPTAKE IN CIGARETTE SMOKING
ARCHIVES OF ENVIRONMENTAL HEALTH 22:55-60, 1971

293

Study was carried out to determine whether smoking (1) regular, (2) low-nicotine-low-tar, or (3) nontobacco (lettuce leaf) cigarettes has a differential effect on carboxyhemoglobin (COHb) level. Each subject participated twice in 5 smoking treatments: T1, subject's usual brand of cigarette; T2, usual brand after passing through a special ring device said to diminish tar and CO content; T3, a low-tar-low-nicotine cigarette; T4, commercially distributed nontobacco cigarette (lettuce leaf); and T5, period of nonsmoking. Each person served as own control for comparing effects of various smoking treatments. Expired-air CO and blood COHb determinations were made 4 times daily. Results indicate that different cigarette preparations do not result in significant variation in a subject's COHb level. There was a difference, however, in COHb between individual smokers. It may be that differences in inhalation practices or factors such as pulmonary function are of some importance in determining whether an individual achieves low, moderate, or high COHb levels while smoking.

CORBERAND J, NGUYEN F, DO A H, DUTAU G, LAHARRAGUE P,
FONTAINILLES A M 757
EFFECT OF TOBACCO SMOKING ON THE FUNCTIONS OF POLYMORPHONUCLEAR
LEUKOCYTES
INFECTION AND IMMUNITY 23(3):577-581, 1979

The effect of smoking on the functions of polymorphonuclear leukocytes was investigated in 68 subjects including smokers and nonsmokers. Ingestion ability, oxygen consumption, and bactericidal activity were normal in smokers. Myeloperoxidase and

neutrophil alkaline phosphatase activities were not changed. Nitroblue tetrazolium reduction and serum lysozyme levels were slightly increased in smokers. However, the capillary tube random migration was depressed and this was further aggravated by intensive smoking. Tobacco smoke may act directly on one or more unidentified target sites of polymorphonuclear leukocytes, which probably plays a role in the development of bronchopulmonary disease in heavy smokers.

COTTEN D J, THOMAS J R, STEWART D 548
IMMEDIATE EFFECTS OF CIGARETTE SMOKING ON SIMPLE REACTION TIME OF
COLLEGE MALE SMOKERS
PERCEPTUAL AND MOTOR SKILLS 33:336, 1971

Fifteen male college students, all smokers, were tested to determine the immediate effects of smoking one cigarette on simple reaction time. Before testing, each subject smoked 45 to 55 mm of an 85-mm non-filtered cigarette. Reaction times were tested when the subjects were asked to press a key as rapidly as possible following the appearance of a light. Experimental sessions measured simple reaction times prior to smoking. An analysis of the test intervals indicated that the mean reaction times immediately following cigarette smoking and 5 minutes after smoking were slower than on all other test intervals. It is concluded that cigarette smoking impedes simple reaction time for a short period.

CRISP Y 821
EFFECTS OF NICOTINE ON HAND STEADINESS IN A MAZE TASK
JOURNAL OF TENNESSEE ACADEMY OF SCIENCE 52(4):150, 1977

The effects of nicotine on hand steadiness were tested in 24 subjects, 12 males and 12 females. The subjects were asked to run through a wire maze task twice, inhaling a regular cigarette immediately before one of the trials. Analysis of variance revealed that subjects made more errors when they smoked immediately before running the maze than when they had not smoked before the trial. Subjects who smoked before the first trial made fewer total errors than those who smoked before the second trial. Males performed better than females before smoking, but smoking seemed to have a greater negative effect on males' performance.

CRYER P E, HAYMOND M W, SANTIAGO J V, SHAH S D 274
NOREPINEPHRINE AND EPINEPHRINE RELEASE AND ADRENERGIC MEDIATION OF
SMOKING-ASSOCIATED HEMODYNAMIC AND METABOLIC EVENTS
NEW ENGLAND JOURNAL OF MEDICINE 295:(11) 573-577, 1976

The effects of a 10-minute smoking interval on plasma levels of neorepinephrine and epinephrine heart rate, blood pressure, blood pressure, blood levels of glycerol, lactate and pyruvate, and plasma levels of growth hormone and cortisol were examined in 10 male smokers (24-42 yrs old). Results indicated an increase in plasma concentrations of norepinephrine and epinephrine following smoking. It is concluded that smoking-mediated changes in heart rate, blood pressure, blood glycerol, lactate, and pyruvate levels occurred before measurable increments in plasma epinephrine and norepinephrine levels. These effects are not mediated by circulating catecholamines. Since adrenergic blockade indicated adrenergic mediation, the smoking-induced increments (in blood pressure, heart rate, and lactate and pyruvate plasma levels) were mediated by a local release of norepinephrine from adrenergic terminals within the cardiovascular tissues rather than by circulating catecholamines. The smoking-induced increments in blood glycerol followed increments in blood catecholamine. Levels may have been mediated by either locally released or circulating catecholamines. Thus, smoking-initiated sympathetic discharge stimulation could mediate acute adverse effects (e.g., myocardial infarction or sudden death) of smoking in persons with coronary artery disease if such discharges coincided with a period of ventricular electrical vulnerability (fibrillation).

DANAHER B G, LICHTENSTEIN E, SULLIVAN M J 292
 COMPARATIVE EFFECTS OF RAPID AND NORMAL SMOKING ON HEART RATE AND
 CARBOXYHEMOGLOBIN
 JOURNAL CONSULTING CLINICAL PSYCHOLOGY 44(4):556-563, 1976

The experiment was initiated by the two normal smoking conditions, followed by the rapid smoking and concluded by rapid breathing. Subjects completed negative behavior checklist and an aversion rating. The final rest period following the last trial spanned 15 min. For regular smoking conditions, subjects were instructed to smoke one cigarette for 5 min. Rapid smoking resulted in greater increases in heart rate (HR) than by regular smoking or rapid breathing with sham smoking. Differences in expired carbon monoxide (CO) and estimated blood carboxyhemoglobin were not significant. No changes in HR (baseline 75 bpm) were found with rapid breathing/sham smoking. Normal smoking with both low and high nicotine produced about the same increases in HR from baseline (72-78 bpm). Rapid smoking with no nicotine increased HR to peak of 85-90 bpm from baseline 78; rapid smoking with both low and high nicotine increased HR to peak of 105-110 bpm from baseline 75-80 bpm. Results showed that rapid smoking produces relatively greater stress on the cardiovascular system than normal smoking.

DA SILVA A M T, HAMOSH P 568
 EFFECT OF SMOKING A SINGLE CIGARETTE ON THE SMALL AIRWAYS
 JOURNAL OF APPLIED PHYSIOLOGY 34:(3) 361-365, 1973

Respiratory function of 21 subjects was measured before and after smoking a nonfilter cigarette in 5 minutes. Airway resistance increased after smoking; conductance and specific conductance decreased. Maximum expiratory flow at 50% of vital capacity also decreased after smoking. All other measures (including nitrogen washout) did not change after smoking. No significant difference in responses between smokers, nonsmokers, and subjects with chronic bronchitis was found. The results indicate that smoking produces increased resistance in the large airways, but does not prove that small airways show increased resistance as well.

DAVID K H 622
 AGE, CIGARETTE SMOKING, AND TESTS OF PHYSICAL FITNESS
 JOURNAL OF APPLIED PSYCHOLOGY 52:(4) 296-298, 1968

The relationship between the number of packages of cigarettes smoked per day and performance was examined using physical fitness tests of different levels of strenuousness. Age correlated with physical fitness test performance but showed no interaction with smoking level. Age was used as a covariate with smoking

amount as the independent variable. A multiple linear regression revealed that performance was decreased for more strenuous tasks (crawling test, dodge and jump test, and one-mile run test), but was not decreased for tasks that required only minimal activity (climbing test, and throwing accuracy test). A comparison of the six smoking levels (0, 0 to 1/2 pack/day, 1/2 to 1 pack/day, 1 to 1 1/2 packs/day, 1 1/2 to 2 packs/day, and >2 packs/day) revealed significant performance decreases in the predicted direction as a function of smoking amount and task strenuousness. It is concluded that decreases in performance with increased smoking amount are a result of decreased efficiency of circulatory and respiratory systems in tasks requiring high physical activity levels.

DAWLEY H H, ELLITHORP D B, TRETOLA R 291
 AVERSIVE SMOKING: CARBOXYHEMOGLOBIN LEVELS BEFORE AND AFTER
 RAPID SMOKING
 JOURNAL BEHAVIOR THERAPY EXPERIMENTAL PSYCHIATRY 7:13-15, 1976

A pilot study of 10 individuals (average age 22) was undertaken. Arterial blood samples were obtained 5-10 min before and after a period of rapid cigarette smoking and determination made of oxygen and carbon dioxide tensions, hemoglobin concentration, oxyhemoglobin and carboxyhemoglobin percentage, and pH. Preliminary analysis reveals an average increase in carboxyhemoglobin of 3.08% with an average value of 4.2% before rapid smoking and 7.28% after smoking. As expected, oximetrically determined oxygen saturation decreased on the average 5.58% (before 95.5% after 89.9%) and oxygen tension decreased 7.6 mm Hg (before 89.7 mm Hg; after 82.1 mm Hg). The data suggest significant decrease in arterial oxygen saturation following rapid smoking. The need for careful screening designed to rule out smokers prone to cardiovascular disease is reiterated.

DEBAS H T, COHEN M M, HOLUBITSKY I B 267
 EFFECT OF CIGARETTE SMOKING ON HUMAN GASTRIC SECRETORY RESPONSES
 GUT 12:93-96, 1971

Effects of smoking 3 cigarettes over a 1 hr period on the pentagastrin-stimulated submaximal plateau of acid secretion was determined from 54 tests in male and female smokers and non-smokers (n = 12, 21-56 years old). The mean plateau output of acid was 4.56 mequiv/15 min or 42% of the maximum response. There was no comparable pepsin response. Stimulation of acid output was observed in another subject which occurred following the smoking hour. Mean plateau output of acid was 4.18 mequiv/15 min or 46% of the maximum response. Pepsin response reached 180% of the control value. Although some individuals experience a

secretory response, smoking 3 cigarettes over a 1 hr period has a negligible overall effect on human gastric secretion. It seems unlikely that smoking may exert a harmful effect on the normal human stomach. However, this conclusion does not apply to the ulcer patient.

DE GOOD D E, VALLE R S 36
 SELF-REPORTED ALCOHOL AND NICOTINE USE AND THE ABILITY TO CONTROL
 OCCIPITAL EEG IN A BIOFEEDBACK SITUATION
 ADDICTIVE BEHAVIORS 3:13-18, 1978

College-aged males ($n = 24$), identified as users or nonusers of nicotine, underwent four 40-min eyes-closed occipital alpha (8-13 Hz, 10 uV) biofeedback sessions over a 4-week period. One-half of the subjects attempted to enhance their alpha production; the other half to suppress it. Neuman-Kuels statistical testing indicated that users and nonusers of nicotine were different from one another. Results were consistent with the hypothesis that nonusers of nicotine are better able to regulate their EEG in a biofeedback training situation than are users. Because of the 4-hr abstinence prior to each training session, it was likely that nonacute influences of chronic nicotine use were observed.

DIETZ R, SCHOMIG A, KUSTERER K, DART A M, KUBLER W 171
 VASOPRESSOR SYSTEMS DURING SMOKING IN HUMANS
 KLINISCHE WOCHENSCHRIFT 62 (SUPPL 2):11-17, 1984

This study correlated the effects of cigarette smoking with the activity of vasopressor systems in humans with changes in heart rate (HR) and blood pressure (BP) and compared them with changes observed after physical exercise or graded norepinephrine (NE) infusion. No relationship was established between changes in either plasma angiotensin II or vasopressin concentration and hemodynamics. There was a small increase in both hormones during smoking of 5 cigarettes. A comparable negative correlation was found during graded NE infusion without smoking. During exercise, increased HR occurred with increased NE. Beta adrenergic blockade (200 mg metoprolol, p.o.) shifted HR and BP to lower values; beta blockade did not antagonize smoking induced increase in BP, HR, and NE. HR, systolic BP, and diastolic BP increased during and decreased from peak values after smoking 5 cigarettes. HR and NE showed negative correlation both following smoking and during i.v. NE (0.01 to 0.3 ug/kg/min) without smoking. During exercise, increased HR and BP occurred with increased NE.

DILL D B, EDWARDS H T, FORBES W H 281
 TOBACCO SMOKING IN RELATION TO BLOOD SUGAR, BLOOD LACTIC ACID,
 AND METABOLISM
 AMERICAN JOURNAL OF PHYSIOLOGY 109:118-122, 1934

The effects of cigarette smoking on blood sugar and lactic acid concentrations, respiratory quotient (RQ), and metabolic rate were determined in subjects ($n = 10$) in the fasting state 900 min before and 45 min following smoking 1 cigarette and in subjects ($n = 2$) about 3 hours after a light breakfast. Smoking had no appreciable influence on lactic acid concentration in venous blood. In another experiment, a male subject smoked 6 cigarettes in 2 hours following a light breakfast and had a blood sugar value of 95. In the following 2 hours, he smoked 2 cigarettes and a cigar. The observations on blood sugar within this period ranged from 92 to 95. After smoking was discontinued and in the succeeding 1.5 hours, 5 of 6 blood sugar values ranged from 92 to 96. Smoking had no appreciable effect on blood sugar or RQ. While the metabolic rate after smoking remained unchanged in some subjects, in other subjects it increased between 5% and 15%. Smoking 1 cigarette produces no change in blood sugar, lactic acid, or RQ.

DOMINO E F, VON BAUMGARTEN A M 75
 TOBACCO CIGARETTE SMOKING AND PATELLAR REFLEX DEPRESSION
 CLINICAL PHARMACOLOGY AND THERAPEUTICS 10(1):72-79, 1969

The patellar reflex was elicited automatically every 2 sec by a reflex hammer (exerting a pressure of 0.5 kg) attached to a solenoid. A negligible depression was produced by smoking a nicotine-free lettuce cigarette. Following a nicotine-containing cigarette, depression of the patellar reflex was progressive and reached its peak at the end of smoking. After smoking, the depression remained at near the same level for 30-120 sec followed by progressive recovery with greatest rate of recovery in the first 10 min. Reflex response returned to normal within 25 min after smoking. Cigarettes with a nicotine content of 0.80 mg produced 45% depression of the patellar reflex and those with 1.69 mg, 67% depression. Smoking a second cigarette 25 min after the first resulted in a reproducible homologous depression indicating that no accumulation or tachyphylaxis took place in this time interval. No differences were observed between smokers and nonsmokers. Tobacco smoking produces a short-term depression of the patellar reflex that seems to be related to nicotine content of the cigarette smoked.

DUBREN R 856
THE EFFECTS OF SMOKING ON ANXIETY
DISSERTATION ABSTRACTS INTERNATIONAL 36(11-B):5786B, 1976

The effects of cigarette smoking and smoking deprivation on anxiety level were examined in 64 smokers and 32 ex-smokers who were exposed to a stress-inducing film. Nicotine deprivation was studied by having one group of smokers smoke freely while another group of smokers abstained for 2 hours preceding the film. The immediate pharmacological effects of nicotine were examined by having the smokers smoke (pre-load group) or not smoke (no pre-load group) immediately preceding the film. Results indicated no withdrawal symptoms of anxiety, depression, and hostility measured by the Zukerman Multiple Affect Adjective Check List and a bipolar "craving" rating scale. It is assumed that the self-dosing pattern of an average of 13 cigarettes at the time of the experiment reduced the appearance of withdrawal effects after 2 hours of abstinence. No significant differences were revealed between the pre-load and no pre-load smokers on a process anxiety rating scale during the film nor were any differences found on state anxiety as measured by the Spielberger Anxiety Inventory after the film. There was a significant increase in the variability of process anxiety ratings for the pre-load condition and non-smoking ex-smokers. These results are more consistent with viewing nicotine as a stimulant than as a tranquilizing agent. There was no indication that the level of anxiety reaction to the film had any effect on subjects choosing to smoke after the film. This choice seemed to be mediated by the level of nicotine dependency and not by level of stress. The smokers who chose to smoke following the film had a tendency to become more relaxed after the film than smokers who did not smoke. It is concluded that because this smoking behavior emphasized cigarette lighting and holding at the expense of inhalation, the observed anxiety-relief was derived from the psychological relief of a "security operation" and/or from the oral-manipulative-motor activities that smoking involves.

ECKSTEIN J W, WOOD J E, WILKINS R W 878
 COMPARATIVE VASOCONSTRICTOR EFFECTS OF INHALING TOBACCO SMOKE IN
 WARM AND COOL ENVIRONMENTS AND BEFORE AND AFTER ABSTINENCE FROM
 TOBACCO
 AMERICAN HEART JOURNAL 53:455-462, 1957

The vasoconstrictor response of smoking was studied by comparing blood flow responses in the foot for smoking with and without a period of abstinence under control conditions of vasomotor activity with those responses produced by a cool environment. Heart rate and blood pressure increased and skin temperature decreased during smoking in both the warm and cool rooms. When subjects abstained from smoking for 24 or 48 hours, the responses were similar. Foot blood flow reduction was greater on cooling the room than on smoking 2 cigarettes. These results indicate that the control levels of vasomotor activity do not significantly change the vasoconstrictor effects of smoking.

EDWARDS A S 329
 THE EFFECT OF SMOKING ON TREMOR
 JOURNAL APPLIED PSYCHOLOGY 32:150-158, 1948

This was a study of the effect of smoking on finger tremor as measured throughout control and experimental situations with a finger tremometer. The experimental situations included: smoking one-half a cigarette; taking eight puffs on a cigarette in 1 minute; smoking with and without inhaling; smokers abstaining from smoking for 2 hours; smoking denicotinized cigarettes; smoking corn silk with and without inhaling; and breathing in a smoke-filled room. Increases in finger tremor were found in smoking of standard tobacco cigarettes with inhaling, in smoking denicotinized cigarettes and inhaling, and in smoking cigars and pipes with inhaling. Smoking half a cigarette increased tremor by 18% and 39% in 50 nonsmokers and 50 smokers, respectively; 8 puffs/min increased tremor 65% and 84% in nonsmokers and 80 smokers, respectively. During withdrawal (2 hrs abstention in 100 smokers), tremor decreased by 30% and was reversed (30% increased tremor) by resumption of smoking. It is concluded that nicotine and inhaling of cigarette smoke produce finger tremor.

EDWARDS J A, WESNES K, WARBURTON D M 150
 EVIDENCE OF MORE RAPID STIMULUS EVALUATION FOLLOWING CIGARETTE
 SMOKING
 ADDICTIVE BEHAVIORS 10:113-126, 1985

Male smokers who smoked more than 15 cigarettes daily performed a rapid visual information processing (RVIP) task requiring detection of a sequence of three consecutive odd or even digits in a

series presented singly on a TV screen, at a rate of 100 digits/min. At 10-20 min after smoking, response time decreased from 527 ± 76 msec to 511 ± 52 msec for a 0.9 mg cigarette, and to 504 ± 63 msec for a 1.5 mg cigarette. Smoking resulted in subjects' detecting targets more quickly and accurately on the RVIP task in the first 10 min following smoking. There was no evidence of trade-off between speed and accuracy. Event-related potentials measured by applying signal-averaging techniques to the EEG were studied by their P300 components, a peak having an approximate latency of 300 msec post-stimulus. Decreases in P300 latency followed smoking. Smoking results in improved ability to deal with RVIP task (improved performance), reaches the brain quickly, with a half-life of 20 min. A form of dependence may be associated with the knowledge that a cigarette has positive benefits for behavioral efficiency.

EK S, FROBERG J, KAGAN A, KARLSSON C G, LEVI L, PALMBLAD J 346
CIGARETTE SMOKING, NICOTINE CONTENT, COGNITIVE FACTORS AND
PSYCHOSOCIAL STRESSORS: AN EXPERIMENTAL STUDY OF PHYSIOLOGICAL
AND PSYCHOLOGICAL EFFECTS IN SMOKERS, NONSMOKERS AND ABSTAINERS
DTIC TECHNICAL REPORT NO. AD/B023978

Hypotheses on the effect of nicotine on physiological and psychological variables under conditions that could be relevant to real life were tested in a study of nonsmokers (19), abstainers (25), and smokers (85) who were divided into 12 groups. After a control period, subjects were exposed to a stressor or a bland film. Nonsmokers had a greater ability to concentrate and higher serum iron and zinc levels, which continued for the stress levels. Information that a high-nicotine cigarette was being smoked did not affect any factor in the same way as smoking high-nicotine cigarettes. For those informed of the content in both high and low subgroups, ability to concentrate fell and serum zinc levels increased less than for other smoking groups. Smoking high-nicotine cigarettes did increase epinephrine excretion, thyroid activity, and self-ratings of subjective arousal, but norepinephrine excretion decreased, plasma lipids increased equally in all groups, and serum iron was not affected. Low-nicotine cigarettes had effects similar to high-nicotine but to a lesser extent regarding epinephrine excretion, fatigue, dizziness, and nausea. Finally, high-nicotine smokers did not prove to be less stressed by psychosocial stressors than abstaining smokers or nonsmokers.

ELGEROT A 349
 NOTE ON SELECTIVE EFFECTS ON SHORT-TERM TOBACCO ABSTINENCE ON
 COMPLEX VERSUS SIMPLE MENTAL TASKS
 PERCEPTUAL AND MOTOR SKILLS 42:413-414, 1976

Five tests involving different aspects of cognitive functioning were given to habitual smokers and "inhalers" with a daily consumption of 15 to 25 cigarettes: "Raven's Progressive Matrices," a non-verbal reasoning test; "Letter Series," a reasoning test in which a subject was required to find the logical principle underlying the construction of letter series; "Mental Arithmetic," an unpublished complex test by Norinder in which a subject had to add and subtract a series of one-digit numbers according to certain rules; Bourdon test on perceptual speed; and proofreading of words and figures. Each subject was tested under an abstinence and a smoking condition, spaced 1 week apart, the order of conditions being rotated among subjects. Subjects solved more items correctly in "Raven's Progressive Matrices," in "Letter Series" and in "Arithmetic" during abstinence than they did in the smoking condition. In "Bourdon test" and "Proofreading," performance did not differ between the two conditions. The results suggest that temporary abstinence from tobacco tends to enhance performance in complex cognitive tests, while simple perceptual tests are not affected. Thus, the view commonly held among habitual smokers that smoking sharpens the intellect was not supported by the present data.

ELGEROT A 248
 PSYCHOLOGICAL AND PHYSIOLOGICAL CHANGES DURING TOBACCO ABSTINENCE
 IN HABITUAL SMOKERS
 JOURNAL CLINICAL PSYCHOLOGY 34:759-764, 1978

Effects of 4 days of abstinence from tobacco smoking were examined in 11 habitual smokers at their usual place of work. Prior to the experiment each subject answered a questionnaire on smoking habits, and a urine sample for catecholamine analysis was collected. Subjects kept detailed diaries and were given a series of cognitive tests at the end of each of two 4-day experimental periods, one smoking and one nonsmoking. Urine samples were collected each morning. Epinephrine excretion was consistently lower during the abstinence than during the smoking. Norepinephrine excretion showed the same pattern, but the differences between conditions were significant only during the 3rd day. Performance on cognitive tests was unaffected. Irritation and disturbances in social relations and activities were reported frequently. Abstinence from tobacco smoking is accompanied by a decrease in arousal and by profound changes in mood and social activities.

ELLIOT R, THYSELL R 290
A NOTE ON SMOKING AND HEART RATE
PSYCHOPHYSIOLOGY 5(1):280-283, 1968

Ten males, all habitual smokers, were tested on two occasions in the morning after a night's abstinence, smoking for 5 minutes, sham smoking, and deep breathing. The smokers rested at a HR of about 77 bpm upon awakening at 8:30 AM. The resting HR levels for the same smokers when tested at 11:30 AM, again without having smoked since awakening, were about 74 bpm. The resting levels for these smokers, when tested at 11:30 AM after smoking in their usual fashion (about 7 or 8 cigarettes) since awakening, averaged about 88 bpm, an elevation of 14 bpm over the comparable resting levels and one which was significant. Neither sham smoking nor deep breathing increased HR. The implication was that, in experiments in which cardiovascular measures are to be recorded, smokers who smoke habitually should be abstinent for at least an hour prior to studies.

ENGELBERG H 464
CIGARETTE SMOKING AND THE IN VITRO THROMBOSIS OF HUMAN BLOOD
JOURNAL AMERICAN MEDICAL ASSOCIATION 193:(12)1033-1035, 1965

Effects of smoking on thrombus formation in blood was determined in 60 patients (n = 40 men, 20 women; 17-68 yrs old) using the Chandler apparatus, which produces a platelet-head thrombus in vitro. Blood was drawn prior to and 20 min after subjects smoked 2 cgt. and thrombus formation was measured before and after smoking. In 34 of the 60 habitual smokers, the in vitro thrombus formation time was decreased following smoking; in 23 subjects the time was unchanged; and in 3 subjects the time was increased. The average change was significant. When blood was repeatedly drawn over a period of several hours, there was variability of thrombosis time. This variability was not due to the emotional factors of the procedure but probably the result of smoking and nicotine-induced secretion of epinephrine. The disparity seen between thrombus formation times and clotting times after smoking emphasized that thrombosis and coagulation are different processes. It is suggested that the increased thrombotic tendency is mediated via the nicotine-induced release of epinephrine. This hyperthrombotic state is a major etiological factor in the increased incidence of acute myocardial infarction in habitual smokers.

ERDREICH J 359
STUDY OF AURAL NONLINEARITY AND THE MECHANISMS OF AUDITORY
FATIGUE
DTIC TECHNICAL REPORT NO. AD/A 080059, 1979

This progress report on a study of susceptibility to auditory threshold shifts includes a report on preliminary data concerning the effects of smoking. Eighteen males were exposed to fatiguing tones at 1 kHz and 2 kHz at 95 dB SPL and to 2 kHz at 90 dB SPL. Smokers and nonsmokers showed no difference in prefatigue thresholds. At 1 kHz smokers showed greater susceptibility to threshold shifts. At 2 kHz, there was a trend in the same direction with a 90-dB SPL fatiguer but not with a 95 dB SPL fatiguer.

ERWIN C W 500
CARDIAC RATE RESPONSES TO CIGARETTE SMOKING: A STUDY UTILIZING
RADIOTELEMETRY
PSYCHOPHYSIOLOGY 8(1): 75-81, 1971

The ECGs obtained with radiotelemetry were studied for 10 subjects who were observed for .26 hr during which they spontaneously smoked 50 cigarettes. The quality of the telemetered EKG was good. There were no consistent rate alterations that were not related to an obvious activity and the heart rate did not change during or after a cigarette was smoked. There was slight evidence that cigarette smoking caused increased rates in subjects with low base rates, but none for those with an initial high rate. These results differ from other studies, perhaps due to the telemetry technique which allows subjects to be ambulatory and their smoking behavior to be spontaneous.

FABRICANT N D, ROSE I W 605
 EFFECT OF SMOKING CIGARETTES ON THE FLICKER FUSION THRESHOLD OF
 NORMAL PERSONS
 EYE, EAR, NOSE & THROAT MONTHLY 30:541-543, 1951

Other studies have shown that following abstinence from smoking, the first cigarette smoked causes an increase in frequency of flicker and with continued smoking, flicker rate increase was antagonized. The present study measured 50 normal males (20-43 yrs of age) who habitually smoked 3-30 cigarettes daily. No period of abstinence was observed, and individual flicker rate prior to smoking was obtained from the average of 10 readings. After subjects smoked a cigarette, 10 additional readings were recorded and averaged to individual flicker rate after smoking. Flicker fusion rate increased in 40 persons and decreased in 10 persons. Mean flashing increased from 44.3 Hz before smoking to 45.0 Hz after smoking. The response was greater and more significant the longer time elapsed following the last smoking period. The flicker fusion rate increase is thought to be caused by the increase in oxygenation to neural tissues from increased blood flow after smoking.

FADEN A, MENDOZA E, FLYNN F 710
 SUBCLINICAL NEUROPATHY ASSOCIATED WITH CHRONIC OBSTRUCTIVE
 PULMONARY DISEASE
 ARCHIVES NEUROLOGY 38:639-642, 1981

A cross of patients with chronic obstructive pulmonary disease (COPD) was studied to determine whether polyneuropathy commonly occurs and whether any specific toxins could be implicated in the cause of this condition. Three groups were given clinical and electrophysiological examinations: patients with moderately severe COPD (Group 1), age-matched controls with normal pulmonary function (Group 2), and normal, younger controls (Group 3). Motor and sensory conduction studies were performed on all subjects in Groups 2 and 3. Twenty of 23 Group 1 subjects showed evidence of peripheral nerve dysfunction. Abnormalities affecting the sural nerve, ulnar nerve, radial nerve, and median nerve were most common. Clinical signs of neuropathy were found in four patients. Sensory nerve function and smoking history were correlated for each of the sensory nerves tested. Results indicated that subclinical polyneuropathy commonly occurs in conjunction with COPD and that this condition is correlated with cigarette smoking. It is suggested that nicotine, taken on a long-term basis through smoking, may be a substance toxic to peripheral nerves.

FAGERSTROM K O, GOTESTAM K G 37
 INCREASE OF MUSCLE TONUS AFTER TOBACCO SMOKING
 ADDICTIVE BEHAVIORS 2:203-206, 1977

Nicotine levels and interpuff intervals were measured on 6 subjects smoking cigarettes. EMG readings were taken from the trapezius muscle before, during and after smoking between inhalations. Phase I simulated smoking, hand mouth movements same as in actual smoking, unlit cigarette used. Phase II, smoking 1/2 of 1 whole cigarette; Phase III, simulated smoking, same as Phase I. During smoking it was found that muscle tone increased in a dose-dependent fashion. Divergent trends appeared between conditions. Differences in trends between low and high nicotine levels and low and levels high with rapid smoking were obtained. There was no difference between high nicotine level and high levels with rapid smoking. In Phase III, differences in trends found in Phase II converged. The converging trend between low and high level with rapid smoking was significant. The 2 other pairs, high and low nicotine levels and high and high levels with rapid smoking did not differ significantly from each other. The results clearly indicate tobacco consumption affects muscle tone dose-dependently. The usual statement that smoking is relaxing was not supported by the results of this study.

FELLER R P, HALE H B 872
 HUMAN SYMPATHOADRENAL RESPONSIVENESS IN AUTUMN, WINTER AND SPRING
 DTIC TECHNICAL REPORT NO. AD/L 417650, 1963

This experiment studied the joint effects of cold, smoking, and anxiety on sympathoadrenal activity. Urinary catecholamine determinations were made for 231 subjects tested at thermoneutrality in autumn, winter, and spring. Epinephrine and norepinephrine output and the nonepinephrine/epinephrine ratio varied with season. The ratio provided the most clear-cut seasonal variation. Norepinephrine appears to be the dominant catecholamine in winter. Smoking caused elevation in epinephrine in all seasons, and smoking plus anxiety acted to intensify the epinephrine response to the cooler seasons. Anxiety may have led smokers to smoke more heavily, which would explain why smoking plus anxiety increased epinephrine output.

FERSON M, EDWARDS A, LIND A, MILTON G W, HERSEY P 758
 LOW NATURAL KILLER-CELL ACTIVITY AND IMMUNOGLOBULIN LEVELS
 ASSOCIATED WITH SMOKING IN HUMAN SUBJECTS
 INTERNAL JOURNAL OF CANCER 23:603-609, 1979

To determine if the association between smoking and the increased incidence of cancer may be due to an effect on natural killer-cell activity, the blood leukocytes of normal and melanoma

patients including smokers and nonsmokers were studied. The natural killer-cell activity of blood leukocytes from both normal subjects and melanoma patients who smoked was significantly lower against cultured melanoma cells than that of nonsmokers. Smokers also had low IgG and IgA immunoglobulin levels in their sera when compared with nonsmokers. However, the percentage of E rosetting cells did not differ. These results support the belief that low natural killer cell activity and immunoglobulin levels in smokers may be related.

FERTIG J, SEYLER L E, POMERLEAU O, HUNT D, PARKER K 861
RELEASE OF FIVE HUMAN PITUITARY HORMONES DURING CIGARETTE SMOKING
CORRELATES WITH NAUSEA AND NOT WITH NICOTINE DOSE
CLINICAL RESEARCH 666A, 1982

To determine if hormone release due to tobacco smoking is nicotine dose-dependent, 10 men were tested in 25 sessions of smoking 2 cigarettes. Serial sessions compared responses to cigarettes of the following nicotine content (in mg): 0, 0.48, 2.87, and 2.87, smoked as rapidly as possible. Growth hormone (GH) increases and Neurophysin I (NSN) increases occurred in 2 subjects on 3 occasions either when smoking 2.87 mg nicotine cigarettes or when rapidly smoking 2.87 nicotine cigarettes. Both subjects became nauseated just before NSN rise on all 3 occasions. Only GH increased in another subject who smoked 2.87 mg nicotine cigarettes rapidly. Tests with 1 male and 1 female (both susceptible to motion sickness), reading during a twisting car ride, indicated that, after onset of nausea and sweating for both subjects, NSN increased for both and GH increased in the male. Because 8 of 10 subjects were refractory to NSN or GH increases, even when smoking high-nicotine cigarettes, these hormonal responses seem to be related to smoking-induced nausea stimulus rather than to nicotine dose. GH increases may accompany nausea but represent a less specific stress response.

FEWINGS J D, RAND M J, ET AL. 73
THE ACTION OF NICOTINE ON THE BLOOD VESSELS OF THE HAND AND
FOREARM IN MAN
BRITISH JOURNAL PHARMACOLOGY 26:567-579, 1966

Water-filled, temperature controlled plethysmographs were used to measure blood flow through the hands and blood flow through the forearms. Intra-arterial injections of nicotine (0.4 or 0.5 mg) were administered (n = 19). In every case, there was an increase in blood flow in the injected forearm within 2 min of injection. The predominant effect of nicotine was to cause vasodilation. The presence of two minor vasoconstrictor components was apparent. The first of these components was a sympathetic reflex

response to the pain of the nicotine injection. The second vasoconstrictor component, unmasked when sensory nerves from the limb were blocked, was a local effect of nicotine that was adrenergic in nature (since abolished by phenoxybenzamine) and was absent in the sympathetically denervated limb. The vasodilator action of nicotine was not adrenergic and was not dependent on the peripheral sympathetic nerves. It is most probably a direct local effect on smooth muscle. Hexamethonium bromide antagonized both vasoconstrictor and vasodilator effects of nicotine.

FINLEY T N, LADMAN A J 754
 LOW YIELD OF PULMONARY SURFACTANT IN CIGARETTE SMOKERS
 NEW ENGLAND JOURNAL OF MEDICINE 286(5):223-227, 1972

Pulmonary surfactant levels taken from the lungs of smokers and nonsmokers were studied by making an analysis of lipids. When compared with nonsmokers, endobronchial lavage of smokers showed a deficit in surface-active material. The volume of surfactant rapidly returned to the same levels as those of nonsmokers when the subject stopped smoking. There was no qualitative difference in the lipid analysis of surfactant from smokers and nonsmokers. However, the total lipid content, especially lecithin, was seven times less in smokers. This supports the reduction of surfactant production or increase in its removal by cigarette smoking.

FRANKENHAEUSER M, MYRSTEN A, POST B
 PSYCHOPHYSIOLOGICAL REACTIONS TO CIGARETTE SMOKING
 DTIC TECHNICAL REPORT NO. AD 868837, 1969

Effects of cigarette smoking on adrenomedullary, cardiovascular, and psychomotor functions were determined in male subjects (n=9, 19-24 yrs old) over a 90-min period. Epinephrine excretion was lowest in the control condition and highest in the strong cigarette condition (2.3 mg/cgt). Excretion rates varied between 4.3 and 7.8 mg/min. For norepinephrine, excretion was highest in the control condition (26.3 mg/min) and lowest in the strong cigarette condition (21.8 mg/min). Epinephrine increase after weak cigarettes (1.3 mg/cgt) was about 38%; after strong cigarettes, about 83%. The corresponding decrease in norepinephrine excretion was 8% after weak cigarettes and 12% after strong cigarettes. Smoking increased heart rate and blood pressure and decreased skin temperature and hand steadiness. Increases and decreases were more pronounced following stronger cigarettes. Choice-reaction time decreased after smoking; however, changes were not statistically significant. Small doses of nicotine, 1.3-2.3 mg/cgt) produce pronounced and long-lasting changes in adrenomedullary, cardiovascular, and psychomotor functions.

FRANKENHAEUSER M, MYRSTEN A L, POST B, JOHANSSON G 365
 BEHAVIORAL AND PHYSIOLOGICAL EFFECTS OF CIGARETTE SMOKING IN A
 MONOTONOUS SITUATION
 DTIC TECHNICAL REPORT NO. AD 883766, 1970

The effects of smoking on efficiency were determined in male students ($n = 12$, 20-26 yrs old) in a sustained visual reaction-time test under monotonous conditions. The subject's task was to respond to a light signal given at irregular intervals of 1-3 sec by pressing a button with his dominant hand. In a control session without smoking, efficiency decreased over time. In the smoking session where subjects smoked 3 cigarettes at 20-min intervals, their initial level of performance was maintained throughout the session. Mean reaction times were shorter in the smoking than in the control session. Smoking produced an increase in heart rate and epinephrine excretion. Nicotine may act as a stimulant and increase behavioral efficiency. Smoking may enhance mental endurance and counteract impairment of performance which normally occurs under monotonous conditions. However, no evidence exists regarding a nicotine-induced increase of efficiency above the level achieved in the initial non-fatigued state.

FRANKENHAEUSER M, MYRSTEN A L, POST B, JOHANSSON G 314
 BEHAVIORAL AND PHYSIOLOGICAL EFFECTS OF CIGARETTE SMOKING IN A
 MONOTONOUS SITUATION
 PSYCHOPHARMACOLOGIA 22:1-7, 1971

Sustained performance in a visual reaction time test was studied in 12 moderate smokers. In the nonsmoking condition, efficiency decreased over time. When three cigarettes were smoked at 20-minute intervals, subjects maintained their initial level of performance. The difference in performance in the two conditions was significant. Smoking was also found to increase heart rate and excretion of epinephrine, but did not affect self-ratings of wakefulness and mood. These results suggest that nicotine may counteract the impairment in performance typical under monotonous conditions. This effect may be partly due to release of epinephrine.

FRANKENHAEUSER M, MYRSTEN A L, WASZAK M, NERI A, POST B 322
 DOSAGE AND TIME EFFECTS OF CIGARETTE SMOKING
 PSYCHOPHARMACOLOGIA 13:311-319, 1968

The effects of cigarette smoking with respect to dosage and time were examined in 8 healthy habitual smokers. At each of 4 sessions, each subject smoked either 0, 2, 4, or 6 cigarettes containing 1.4 mg nicotine, administered at 20-min intervals.

Comparison between effects on catecholamine excretion produced by 2, 4, and 6 cigarettes showed a progressive increase in epinephrine excretion with number of cigarettes, while norepinephrine excretion was not noticeably affected. Comparisons between smoking and control conditions showed effects on hand steadiness, skin temperature, heart rate, and blood pressure. There were no differences in these functions between the effects produced by smoking 2, 4, or 6 cigarettes. Dose and time response curves indicated the relatively largest effect was regularly produced by the first cigarette, while the 2nd and 6th cigarettes produced progressively smaller changes. Administration of nicotine appears to be a suitable tool for systematic variation of the activity for the adreno-medullary system.

FRASURE-SMITH N, ROLICZ-WOLOSZYK E 830
 MEMORY PROBLEMS AFTER ISCHEMIC HEART DISEASE EPISODES: EFFECTS
 OF STRESS BENZODIAZEPINES AND SMOKING
 JOURNAL OF PSYCHOSOMATIC RESEARCH 26(6):613-622, 1982

The effects of stress, benzodiazepines and smoking on memory problems reported by post-ischemic heart disease patients were investigated among 157 men under age 65. A general health questionnaire was used to interview patients in the hospital and 1 year later. Twenty-five percent of these patients reported memory difficulties during the year following hospital admission. Only three variables differentiated patients with memory problems from those without: quitting smoking during the year following hospitalization, using benzodiazepines, and having high stress levels 1 year after discharge. Stress appeared to be related to memory problems primarily because high-stress patients were more likely to use psychotropic drugs. It is suggested that the link between quitting smoking and memory problems can be explained by two contradictory effects of tobacco use: a short-acting effect due to nicotine which improves memory, and a longer lasting effect due to atherosclerosis which may impair memory long after the cessation of smoking.

FRIEDMAN J, HORVATH T, MEARES R
 TOBACCO SMOKING AND A STIMULUS BARRIER
 NATURE 248:455-456, 1974

Habituation of the orienting response was examined in male smokers (n = 10, 20-25 yrs old) to determine if smoking increases the effectiveness of a stimulus barrier. Tobacco smoke increased the speed of habituation; placebo smoking had no effect. The habituation point changed in the second session from 16.1 to 16.9; in the third session after a 12-hr deprivation, from 13.8 to 5.6. During the placebo smoking in the fourth session, the

habituation point remained unchanged. The immediate effects of smoking could not be adequately explained in terms of sedation as this was not reflected in measures of arousal. Smoking may cause mild central nervous system excitation as evidenced by an increase in skin conductance and an increase in heart rate in session 3. There was a significant difference between heart rates of deprived and non-deprived subjects before smoking. Smoking induced no significant change in the proportion of alpha activity. Results indicate a possible mechanism of positive reinforcement of tobacco.

FRITH CD 78
PERSONALITY, NICOTINE AND THE SALIVARY RESPONSE
LIFE SCIENCES 7(22):1151-1156, 1968a

The subjects were 20 normal adults aged between 20 and 40 yrs for whom extraversion and neuroticism scores were known. Each subject was given a tablet of placebo or nicotine (containing 0.1 mg) to chew. There was then a 7-min rest, followed by 2 injections of 2 cc of lemon juice separated by 60 secs. The process was then repeated with the other tablet. Half of subjects had nicotine first and half placebo. The number of drops of saliva produced in the 30 sec before the first stimulation (resting level) and in the 30 sec after each stimulation were counted (responses 1 and 2), for both nicotine and placebo (1 drop = 0.004 cc). There was an effect of nicotine on the difference between resting level and response (1 and 2 combined) in the predicted direction of a greater difference with nicotine than with placebo. There was no effect of nicotine in any of the other measures (extraversion, neuroticism, age, resting level, and four speed of response measures).

FRITH CD 805
THE EFFECTS OF NICOTINE ON THE CONSOLIDATION OF PURSUIT ROTOR
LEARNING IN HUMANS
LIFE SCIENCES 7(2 PT. 2):77-84, 1968b

An experiment was conducted to determine the effects of small doses of nicotine on the consolidation of pursuit rotor learning. Twenty men, both nonsmokers and occasional smokers, were given nicotine and placebo in sublingual tablet form and were instructed to track a target using a variable pattern polar tracker. Two indices of performance were extracted: total time on target and mean hit length. The nicotine appeared to be active during the programmed rest and to facilitate the consolidation of previous learning. The effect of nicotine appeared only in the mean hit length scores, not the total time on target scores. This was probably due to a greater error variance in the latter scores resulting from the inclusion of rest pauses in this index.

FRITH CD 79
THE EFFECT OF NICOTINE ON TAPPING
LIFE SCIENCES 6(14)F:1541-1548, 1967

Previous studies have shown that reactive inhibition can be inferred from a tapping task, increasing inhibition shown by increased rest pauses and decreased tapping rate. Rate of tapping on a telegraph key was monitored electronically; subjects tapped for 1 min, smoked at beginning of 10-min rest period, then tapped again for 1 min. Tapping rate, frequency of rest pauses, and average gap length excluding rest pauses were analyzed under low-nicotine (0.1 mg,p.o.) and placebo conditions. Nicotine the frequency of rest pauses and decreased the decline in tapping rate that normally occurs with time. These results suggest decreased reactive inhibition with nicotine compared to placebo.

GARNER L L, CARL E F, GROSSMAN E E 331
 EFFECT OF CIGARETTE SMOKING ON FLICKER FUSION THRESHOLD
 AMERICAN MEDICAL ASSOCIATION ARCHIVES OPHTHALMOLOGY
 51:642-655, 1954

The effect of cigarette smoking on the flicker fusion threshold of 108 healthy adults was observed. Each of the 55 smokers and 53 nonsmokers was tested at least twice. Cigarettes had an effect of raising the flicker fusion frequency in 35 subjects and of lowering it in 21 subjects out of total of 108 tested. Some subjects showed an extreme sensitivity to cigarettes in the flicker tests, while others revealed very little change. Those whose flicker fusion frequency was decreased by smoking showed an increase to the original level after glyceryl trinitrate (nitroglycerin), and apparent relief from vasoconstriction anoxia. Furthermore, it was noted that subjects can absorb enough nicotine by sitting in a smoke-filled room to affect the flicker fusion frequency. The preliminary results as presented here would seem to indicate that regular smokers have a higher degree of variance than do nonsmokers. Thus, the measure of the flicker fusion threshold response may be potentially useful as a practical means of detecting the hyperreactors to nicotine.

GARVEY A J, BOSSE R, SELTZER C C 243
 SMOKING WEIGHT CHANGE AND AGE: A LONGITUDIAL ANALYSIS
 ARCHIVES ENVIRONMENTAL HEALTH 28:327-329, 1974

A cohort of 870 male veterans aged 20-69 years was studied during a 5-year period to determine the effects of age and change in smoking status on body weight. Smoking behavior was divided into four categories: recent ex-cigarette smokers, continuing cigarette smokers, never smokers, and former smokers. The dependent variable was weight change from time 1 (beginning of study) to time 2 (5 years later) in pounds. Regardless of age, the ex-cigarette smoker group gained more weight than did other men. The increase in weight was greatest for quitters between the ages of 40 and 54. Chronological age accounted for 5.1% of the variance of weight change and smoking behavior accounted for 2.4%. The importance of other factors in explaining the weight change is stressed.

GERRARD J W, COCKCROFT D W, MINK J T, COTTON D J, POONAWALA R, DOSMAN J A 752
 INCREASED NONSPECIFIC BRONCHIAL REACTIVITY IN CIGARETTE SMOKERS WITH NORMAL LUNG FUNCTION
 AMERICAN REVIEW RESPIRATORY DISEASE 122:577-582, 1980

The effect of bronchial reactivity in cigarette smokers with normal lung function was studied in 17 smokers and 17 nonsmokers. Smokers showed a significantly greater prevalence of cough,

sputum production, and wheezing than nonsmokers, but not dyspnea. No differences were found in the prevalence of an allergy history, the number of positive reactions to allergy skin tests, or elevated serum IgE. Furthermore, lung volumes, expiratory flow rates, specific airway conductance, and the slope of Phase III of the single breath O₂ test did not differ significantly. The geometric mean provocation concentration of histamine required to reduce the specific airway conductance by 35% was significantly lower in smokers. These results indicate that nonspecific bronchial reactivity may be a factor in the development of airway obstruction in smokers.

GILBERT D G, HAGEN R L 61
 THE EFFECTS OF NICOTINE AND EXTRAVERSION ON SELF-REPORT, SKIN CONDUCTANCE, ELECTROMYOGRAPHIC, AND HEART RESPONSES TO EMOTIONAL STIMULI
 ADDICTIVE BEHAVIORS 5:247-257, 1980

The purpose of this experiment was to study how smoking reduces emotional reactions. Each subject smoked three high-nicotine cigarettes one day and three low-nicotine cigarettes the other day. Subjects rated their bodily and emotional reactions to the stimuli. The high-nicotine condition caused higher heart rates and lower skin conductance than the low-nicotine condition, but did not affect EMG. There was no interaction between extroversion and nicotine for skin conductance or self-reports. On Day 2, perceived muscle tension and startle were lower in the high-nicotine than in the low-nicotine condition. These results are consistent with Eysenck's hypothesis that nicotine decreases cortical arousal, but not with his hypothesis that this effect is greater in introverts than in extroverts. Results from Day 2 only are consistent with the model that nicotine increases perceptual thresholds.

GILBERT D G 870
 EXTROVERSION, TYPE OF SMOKER AND THE EFFECTS OF NICOTINE ON PHYSIOLOGICAL AND SELF-REPORT MEASURES OF EMOTION
 DISSERTATION ABSTRACTS INTERNATIONAL 39(3-B):1477B-1478B, 1978

Habitual smokers (n = 48) smoked high (1.3 mg) or low (0.2 mg) nicotine cigarettes just before watching 11 20-30 sec emotion-producing video scenes. Immediately after each scene, subjects indicated on 7-point scales the intensity of their emotional response and perceived body response. High-nicotine cigarettes increased heart rate more than low-nicotine cigarettes and decreased the square root of skin conductance response magnitude

to the emotional scene. The 2 groups reported no difference in experiencing emotion. Electromyogram indices of muscular activity were not different for the 2 groups. On the second day of the test, self-reports of the high-nicotine subjects indicated a perception of "startle or sudden tensing" and "muscle tension increase" less than did the low-nicotine subjects. No perceived differences in heart rate for the 2 groups and no interaction between nicotine and extroversion (measured by the Eysenck Personality Inventory) were reported. Results offer only weak support for cortical sedation, increased perceptual threshold, and muscular reaction reduction models of mechanism by which nicotine decreased emotion, if it does, in fact, decrease the subjective experience of emotion.

GLAUSER S C, GLAUSER E M, REIDENBERG M M, RUSY B F,
TALLARIDA R J 278
METABOLIC CHANGES ASSOCIATED WITH THE CESSATION OF CIGARETTE
SMOKING
ARCHIVES ENVIRONMENTAL HEALTH 20:377-381, 1970

The relationship between smoking cessation and metabolic changes associated with weight gain was observed in male subjects ($n = 7$, mean age 31.4 yrs) before and 1 month following cessation of smoking. Hematocrit, protein-bound iodine level (PBI), serum cholesterol, hemoglobin, serum calcium, fasting blood glucose, and 30 min post-prandial blood glucose values were taken. Following the cessation of smoking the following factors were changed: body weight from 83.29 kg before cessation to 87.33 kg; body surface area from 2.103 sq.m before cessation to 2.05 sq.m; heart rate from 60 bpm before cessation to 57 bpm; 30 min post-prandial blood glucose from 137 mg% before cessation to 123 mg%; PBI from 5.1 ug% before cessation to 4.6 ug%; serum calcium from 10.2 mg% before cessation to 9.7%; oxygen consumption from 293 ml/min before cessation to 260 ml/min; respiratory quotient from 0.75 before cessation to 0.81. Of the 7 subjects, 6 gained weight during the month between tests and had a decrease in basal oxygen consumption. Metabolic changes following cessation of smoking may cause weight gain.

GOLDING J, MANGAN G L 109
AROUSING AND DE-AROUSING EFFECTS OF CIGARETTE SMOKING UNDER
CONDITIONS OF STRESS AND MILD SENSORY ISOLATION
PSYCHOPHYSIOLOGY 19(4): 449-456, 1982a

Changes in electrodermal conductance, heart rate, and EEG alpha responding due to smoking a 2.3-mg nicotine delivery cigarette were examined in an ambient aversive white noise (stress) and mild sensory isolation (relaxation) conditions. Under the white noise condition, smoking caused an increase in HR from 72 to a

peak of 84 BPM. In the sensory isolation condition, smoking caused an increase in HR from 63 to a peak of 73 BPM. Skin conduction, which was elevated by stress for experimentals and controls, was not affected by smoking in the stress condition, but smoking elevated skin conductance during smoking (5 min) and after-smoking periods with respect to nonsmoking controls in the relaxation condition. The main effect on EEG alpha activity occurred during the smoking period, when in the stress condition smoking caused increase in EEG alpha activity; the reverse was true in the relaxation condition. In summary, cigarette smoking during relaxation produced strong stimulant effects reflected in reductions in EEG (alpha), elevations in skin conductance, and HR. During stress, smoking produced mixed stimulant and depressant effects.

GOLDING J R, MANGAN G L 023
EFFECTS OF CIGARETTE SMOKING ON MEASURES OF AROUSAL, RESPONSE
SUPPRESSION, AND EXCITATION/INHIBITION BALANCE
INTERNATIONAL JOURNAL OF ADDICTIONS 17:793-804, 1982b

The effects of smoking 0.6- and 1.3-mg cigarettes on electrodermal response to a series of auditory stimuli and on spiral after-effect inhibition were measured in 12 smokers. Smoking the 1.3-mg cigarette, increased the rate of spontaneous fluctuation, whereas the no-smoking control and the 0.6-mg cigarette had no significant effect. The habituation rate increased after the 1.3-mg cigarette but not after the 0.6-mg cigarette. Although the initial amplitude effects were different between smokers and nonsmokers they did not differ between smoking groups. Smoking for both groups seemed to have effects on the decline and duration of spiral after-effects, but not on recovery. This apparent failure of self-titration for nicotine with the 0.6-mg cigarette suggests that the approved strategy of switching to safer, 0.7-mg cigarettes may not be successful.

GORDON T, KANNEL W B, DAWBER T R, MCGEE D 232
CHANGES ASSOCIATED WITH QUITTING CIGARETTE SMOKING: THE
FRAMINGHAM STUDY
AMERICAN HEART JOURNAL 90(3):322-328, 1975

Individuals (n = 544) who changed from smoking to nonsmoking had a mean increase in body weight of 3.8 lb, a mean increase in systolic blood pressure of 1.6 mm Hg, and a mean increase in serum cholesterol of 0.2 mg/dl. Controls (individuals who continued smoking during the same period, n = 4,078) had a mean increase in body weight of 0.3 lb, a mean increase in systolic blood pressure of 0.78 mm Hg, and a mean decrease in serum cholesterol of 0.2 mg per 100 ml. For individuals who changed from

nonsmoking to smoking ($n = 246$), compared to controls (in parentheses) who continued not smoking ($n = 3,120$), mean weight decreased 0.9 lb (increased 0.5 lb), mean systolic blood pressure increased 0.6 mm Hg (0.7 mm Hg), and mean serum cholesterol increased 1.9 mg per 100 ml (0.3 mg/dl). Vital capacity was greater for mean smoking 20 cigarettes/day. The chief findings of the Framingham Study were only a greater short-term weight change and smaller long-term decline in vital capacity among those who quit compared to those who continued smoking.

GOTHE B, STROHL K P, LEVIN S, CHERNIACK N S 155
 NICOTINE: A DIFFERENT APPROACH TO TREATMENT OF OBSTRUCTIVE SLEEP
 APNEA
 CHEST 87(1):11-16, 1985

Male patients ($n = 8$) with sleep apnea were studied to examine the effects of nicotine on upper airway obstruction. For the nicotine test study, SS chewed gum containing nicotine (2 mg) for 20 min at hourly intervals starting at 3:00 p.m. and received an additional piece containing nicotine (4 mg) approximately 30 min before the sleep recording began. Nicotine given in this manner had, on the average, no effect on the ventilatory response to hypercapnia. On the average, nicotine produced no effect on heart rate either awake or asleep. Nicotine reduced the total number of apneas during the first and second hour of sleep after the drug. Nicotine did not affect end-tidal CO₂ or O₂ saturation during wakefulness. Nicotine decreased the total number of apneas during sleep due to a decrease in the number of obstructive and mixed apneas. Central apneas were not affected. Nicotine levels in the blood from nicotine chewing gum or cigarettes peaked within 5 or 10 min after administration and declined to one-third of their peak levels in 50 min. Because of its transient effects, nicotine in its present form is not a particularly good therapeutic agent in obstructive sleep apnea.

GRAYBIEL A, STARR R S, WHITE P D 881
 ELECTROCARDIOGRAPHIC CHANGES FOLLOWING THE INHALATION OF TOBACCO
 SMOKE
 AMERICAN HEART JOURNAL 15:89-99, 1938

Electrocardiograms were taken on 45 subjects with hypertension, coronary heart disease, or both after the inhalation of cigarette smoke. Heart rate increased in 39 subjects, arterial blood pressure increased in 24, and electrocardiographic changes were significant for 20 factors other than the heart rate. Decrease in the amplitude of T-waves was observed in 15 instances. T-wave effects were studied further by injecting 6 subjects with atropine. The results were similar to those with cigarette smoking.

This suggests that attacks of angina pectoris precipitated by smoking result from a sudden increase in the work of the heart as shown by increased blood pressure and heart rate rather than from vasoconstriction.

GRIMES D S, GODDARD J 273
EFFECT OF CIGARETTE SMOKING ON GASTRIC EMPTYING
BRITISH MEDICAL JOURNAL 2:460-461, 1978

Gastric emptying after a test meal was measured in male smokers and nonsmokers (n = 17, 20-30 yrs old). The 100 smokers were given 2 test meals consisting of Readybrek (30 g) and milk (200 ml) and smoked 2 cigarettes between meals. The 7 nonsmokers were given 1 meal. The solid component of the meal was labelled with the radioisotope technetium; the liquid component with indium. Emptying curves for technetium and indium were produced by adjusting the initial counts for radioactive decay. Points on the corrected emptying curves were analyzed by the Wilcoxon matched-pairs signed-ranks test. Liquid left the stomach exponentially; solid in a linear fashion. Smoking a cigarette increased the rate at which liquid left the stomach suggesting that the rate of acidification of the duodenum after a meal might be correspondingly more rapid. Solid did not accompany the liquid and did not buffer the excess leaving the stomach. Pathogenesis of duodenal ulcer and the delay in healing may be caused by cigarette smoking.

GRUNBERG NE 16
THE EFFECTS OF NICOTINE AND CIGARETTE SMOKING ON FOOD CONSUMPTION
AND TASTE PREFERENCES
ADDICTIVE BEHAVIORS 7:317-331, 1982

The effects of nicotine and cigarette smoking on food consumption and taste preferences were examined. Subjects ate three sweet, three salty, and three bland foods. Subjects rated the foods for taste and picked three foods for additional rating. Subjects ate as much as they liked of each food. Three types of subjects were studied: nonsmokers, smokers allowed to smoke, and smokers not allowed to smoke. Total food consumption was 180 g for nonsmokers, 145 g for smokers smoking, and 140 for smokers not smoking. Nonsmokers ate significantly more sweets than did smokers smoking and somewhat more sweets than smokers not smoking. There were no differences in consumption of salty and bland foods. Smokers not smoking ate somewhat more sweets than did smokers smoking. It appears that smoking acts specifically to decrease consumption of sweet-tasting foods. These results may help to explain increased body weight that is associated with cessation of smoking.

GUNBY P 008
SNUFF GIVES HR, BP A KICK
JOURNAL AMERICAN MEDICAL ASSOCIATION 247:947, 1982

Male athletes (n = 20; 10 oral tobacco users, 10 controls) were studied. Baseline ECG and BP measurements were made. A 2.5-g pinch of oral tobacco was placed in each subject's mouth. Mean HR (bpm) increased from 69 to 88. Mean BP (mm Hg) increased from 118/72 to 126/78. Both parameters returned to their original levels after the tobacco was removed. Oral tobacco can produce significant hemodynamic effects in both animals and normal humans and poses a health hazard in certain individuals; particularly those with hypertensive predisposition.

HALL A R, BLAKESLEE A F 601
 EFFECTS OF SMOKING ON TASTE THRESHOLDS FOR PHENYL-THIO-CARBAMIDE
 (PTC)
 PROCEEDINGS NATIONAL ACADEMY SCIENCES USA 31:390-396, 1945

This experiment investigated the effect of smoking two cigarettes on PTC threshold. Nearly three-quarters of the 60 subjects, which included both smokers and nonsmokers, required stronger solutions to taste PTC after smoking; 20% could taste weaker solutions after smoking. The length of time before recovery from the effects of smoking varied with the individual. Ten subjects were retested to examine the effect of inhaling smoke through the nose only. The majority showed an initial stimulation of taste, and the remainder showed no initial change; most showed a depression 1/2 to 1 hour later. The initial effect of smoking by mouth, in most cases, appears to be a direct dulling of the taste buds by some product of combustion. The true effect of nicotine on the nerve apparatus for taste appears to be initial stimulation with later depression, a pattern that has been demonstrated for other nerves tested.

HALL R A, RAPPAPORT M, HOPKINS H K, GRIFFIN R 485
 TOBACCO SMOKING AND EVOKED POTENTIAL
 SCIENCE 180:212-214, 1973

The average visual evoked potential of nine smokers was tested after 12 and 36 hours of abstinence from smoking and after resumption of smoking. The amplitude decreased with withdrawal and increased after resumption of smoking, consistent with the contention that tobacco increases arousal. In addition, there was a differential effect favoring responsiveness to weak over strong stimuli. Amplitude changes occurred between 100 and 125 milliseconds after the onset of the flash, suggesting that smoking selectively enhances the perception of weak stimuli. Behavior, mood rating scales, and kinesthetic figural after-effects showed no change with abstinence or resumption of smoking.

HAMMOND E C, GARFINKEL L 578
 SMOKING HABITS AND AGE IN RELATION TO PULMONARY CHANGES
 NEW ENGLAND JOURNAL MEDICINE 269(20): 1045-1059, 1963

A histological study was made of lung tissue specimens from 1,340 patients to determine changes in the parenchyma associated with smoking as a function of age and smoking habits. The least change was noted for patients who had never smoked and the most change was noted for current smokers and those who smoked cigarettes most heavily. Current pipe and cigar smokers showed more changes than nonsmokers. Age was positively associated with all

five histological changes. Older patients tended to have more extensive changes in the parenchyma than younger patients. This was true of both smokers and nonsmokers. Ex-cigarette smokers matched with current smokers for age, race, occupation, and daily cigarette consumption showed less extensive histological changes than current smokers if they had stopped smoking at least 3 years prior to death. The above findings are viewed in light of other experimental, clinical, and epidemiological studies to conclude that cigarette smoking results in histological changes in the parenchyma as well as in bronchial epithelium and bronchial glands. These changes are believed to increase with continued smoking and advanced age.

HAMOSH P, TAVEIRA D A, SILVA A M 572
THE EFFECT OF EXPIRATORY FLOW RATES OF SMOKING THREE CIGARETTES
IN RAPID SUCCESSION
CHEST 72:610, 1977

The effect of chain-smoking three unfiltered cigarettes (each containing 2.5 mg of nicotine) on maximal and partial expiratory flow rates was examined in order to assess the utility of these measures in monitoring airway response to irritants. Using 10 healthy heavy smokers, measures of expiratory flow rates were obtained using a waterless spirometer both before smoking and following a smoking rate of 10 puffs per 5-minute interval for each cigarette. There was a 5-minute interruption between cigarettes for taking measurements. Results indicate a significant decrease in maximal midexpiratory and partial midexpiratory, end-expiratory, and instantaneous flow rates following acute intense smoking. Since decreases in partial expiratory rates were nearly three times greater than decreases of maximal expiratory rates, it is suggested that partial flow rates be used as an indicator of the bronchoconstrictor response to smoke.

HART P, FARRELL GC, COOKSLEY W G E 284
ENHANCED DRUG METABOLISM IN CIGARETTE SMOKERS
BRITISH MEDICAL JOURNAL 2:147-149, 1976

The effects of cigarette smoking on salivary antipyrine disappearance rate as an index of hepatic drug metabolism was determined in male and female subjects (n = 42, 16-63 yrs old). The 25 smokers and 17 nonsmokers were comparable in sex and consumption of coffee, tea, and alcohol consumption. An aqueous solution of antipyrine (10 mg/kg, i.v.) was injected in subjects or administered by mouth dissolved in 100 ml of orange juice. Five or more samples of venous blood (10 ml) or fresh saliva (5 ml) were collected at intervals during the next 30 hrs and assayed by gas chromatography. Plasma and saliva antipyrine

disappearance rates were measured in 5 smokers and 9 nonsmokers. Results from these fluids were nearly identical. The mean antipyrine half-life was lower in smokers than in nonsmokers. No significant correlation was found between age, sex, and antipyrine half-life in these 2 groups. Cigarette smoking enhances antipyrine disappearance rate; smoking contributes to the large variation in rates of drug metabolism seen in man.

HARTLEY L R 555
CIGARETTE SMOKING AND STIMULUS SELECTION
BRITISH JOURNAL PSYCHOLOGY 64:(4), 593-599, 1973

The paced observing response of 15 smokers was tested under three conditions: following relaxation without smoking, following smoking one cigarette, and following smoking two cigarettes. Heart rate was measured before and after each test. The test used a three-channel visual display with a ratio of signal probability of 6 to 3 to 1. Both total number of observations made and the proportion of observations made on the channel with highest signal probability showed an effect of prior smoking; following no smoking, these scores increased during the test, but following smoking, they did not increase. Smoking produced an increase in heart rate, and one cigarette produced nearly as large an effect as two; by the end of testing, though, heart rate fell to the level of the no-smoking condition. These results suggest that smoking reduces the level of arousal during the latter part of the test and prevents changes in performance that accompany a prolonged test.

HEATH C W 599
DIFFERENCES BETWEEN SMOKERS AND NONSMOKERS
ARCHIVES INTERNAL MEDICINE 101:377-388, 1958

A subjective comparison of 252 male nonsmokers, moderate, and heavy smokers; was conducted to assess differences in personality and physiological characteristics. Differences were found for emotional expressiveness, verbal articulateness, choice of armed forces branch of service; temperament; conscientiousness; respiratory and swallowing rates; knee, ankle, bicep, and abdominal reflexes; daily coffee, alcohol, and sugar consumption; weight stability; frequency of urination during stress; and number of skin moles.

HEIMSTRA N W, BANCROFT N R, DEKOCK A R 319
 EFFECTS OF SMOKING UPON SUSTAINED PERFORMANCE IN SIMULATED
 DRIVING TASK
 ANNALS NEW YORK ACADEMY OF SCIENCES 142:295-307, 1967

An investigation was undertaken to determine the effects of smoking on various performance tasks during sustained operation of a simulated driving device. Sixty male college students were divided into smoker, nonsmoker, and deprived smoker groups. Subjects operated the driving device for a 6-hr session and were measured for tracking, reaction time, and visual vigilance. No differences were found between the smoker and nonsmoker groups in any of the performance tasks. The performance of the deprived smoker group was inferior to that of the smokers and nonsmokers on all tasks.

HEINEMANN G, SCHIERELBEIN H, EBEN S 51
 EFFECT OF CIGARETTE SMOKING ON WHITE BLOOD CELLS AND ERYTHROCYTE
 ENZYMES
 ARCHIVES OF ENVIRONMENTAL HEALTH 37(5):261-265, 1982

Healthy volunteers who smoked at least 20 cigarettes/day were instructed to smoke 4 different brands of cigarettes containing different amounts of nicotine (0.5-1.3 mg) and condensate (9.2-19.6 mg) during from 2-week periods. Additional groups with longer smoking histories were instructed to smoke a fifth brand for an 8-week period. Nonsmokers matched for age were measured also. Puff frequency and volume were measured with a smoking registration device. Blood drawn by venipuncture in 2-week intervals was EDTA-anticoagulated; 24-hour urine specimens were collected every 2 weeks. Determination of hematologic values. Coulter Counter S showed no remarkable differences between smokers and nonsmokers, except in WBC count with significantly higher WBC means for smokers than for nonsmokers ($P = .05$) although all values were within the normal range.

HENNINGFIELD J E, MIYASATO K, JASINKI D R 169
 ABUSE LIABILITY AND PHARMACODYNAMIC CHARACTERISTICS OF
 INTRAVENOUS AND INHALED NICOTINE
 JOURNAL OF PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS 234(1):
 1-12, 1985

To determine the role of nicotine in tobacco dependence using the abuse liability assessment, 8 smokers with histories of drug abuse were studied. Each subject was tested with 0.0, 0.75, 1.5, and 3.0 mg/10-sec infusion of i.v. nicotine each test day, and with 0.0, 0.4, 1.4, and 2.9 mg inhaled nicotine on alternate test days. Each route of administration was tested on 4 days. Physiologic, subjective, and observer data were collected at

intervals from 15 sec to 10 min beginning 10 min before administration and ending 30 min after. Nicotine produced similar effects with both methods of administration. Both the duration and magnitude of responses were related directly to the nicotine dose. Heart rate and blood pressure showed dose-related increases, skin temperature decreased, and pupil diameter showed no statistically reliable change. Drug dose strength and ratings were directly related to dose levels, but desire to smoke cigarettes was inversely related. Morphine-Benzedrine Group scores were elevated by nicotine, and i.v. doses were often identified as cocaine. The symptoms of coughing, dizziness, nausea, and relaxed feelings were similar for both routes of administration. Because nicotine shares the pharmacological profile of prototypic drugs of abuse, study data support the role of nicotine in tobacco dependence as being similar to the role of psychoactive drugs in substance abuse.

HENNINGFIELD J E, GOLDBERG S R 306
 CONTROL OF BEHAVIOR BY INTRAVENOUS NICOTINE INJECTIONS IN HUMAN
 SUBJECTS
 PHARMACOLOGY BIOCHEMISTRY & BEHAVIOR 19:1021-1026, 1983

Subjects were studied under a simple fixed-ratio schedule of nicotine or saline injection intravenously infused in a forearm vein. In some studies, sessions were preceded by oral administration of mecamylamine. Overall rates of responding during sessions when nicotine was available were lower than those when saline was available, suggesting that nicotine was serving as a punishing stimulus relative to saline. The acquisition of nicotine self-administration was studied in two subjects without history of drug abuse. These data suggest the possibility that the functional effect had changed with time and repeated exposure from that of punishing to a reinforcing stimulus. In another study, the reinforcing efficacy of nicotine was studied in one subject by giving concurrent access to nicotine (1.5 mg/injection) or saline. Results show that regardless of whether responses on the right or left level produced nicotine, nicotine injections always exceeded saline injections. During each of four consecutive sessions following mecamylamine pretreatments, the number of saline injections equalled the number of nicotine injections. When mecamylamine was replaced with placebo for two sessions, the number of nicotine injections increased, exceeding the number of saline injections. In another study, one subject was tested under a concurrent schedule of nicotine avoidance and nicotine self-administration (1.5 mg/injection). Eleven of the 12 programmed nicotine injections were avoided. Higher doses of nicotine were accompanied by increased rates of lever pressing to avoid injections, and a decrease in the number of programmed injections occurred. It is concluded that the functional behavioral effects of nicotine are diverse. Nicotine can serve as either a positive or a negative reinforcer.

HERNING R I, JONES R T, BACHMAN J
 EEG CHANGES DURING TOBACCO WITHDRAWAL
 PSYCHOPHYSIOLOGY 20(5):507-512, 1983

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The effects of smoking on electroencephalographic changes were studied during tobacco withdrawal (10-17 hours) in 18 heavy smokers. Results indicated that theta and alpha power increased following tobacco deprivation and reduced by nicotine cigarette smoking, but not by placebo smoking. The peak alpha frequency was slower post-deprivation than post-smoking a nicotine cigarette. The decreases were not always significant. Several of the questionnaire items and combinations of items significantly changed over successive cigarettes for Group 1, but no single item or composite of items changed in parallel with EEG spectra changes. It is concluded that the increased theta power during deprivation may be a correlate of drowsiness and may resemble a mild version of a stimulant withdrawal syndrome. Although changes in alpha have been attributed to characterological differences in arousal or cognitive processing of smokers, the present authors suggest that changes in alpha power and peak frequency may be simply secondary to the theta power changes.

HERXHEIMER A, GRIFFITHS R L, HAMILTON B, WAKEFIELD M 504
 CIRCULATORY EFFECTS OF NICOTINE AEROSOL INHALATIONS AND CIGARETTE
 SMOKING IN MAN
 LANCET 2:754-755, 1967

To study the circulatory effects of nicotine, 5 healthy smokers were given 4 preparations: tobacco cigarettes, lettuce-leaf cigarettes, nicotine aerosol, and control aerosol. Heart rate and blood pressure increased during cigarette smoking and inhalation of the nicotine aerosol. The increases were similar for each group. The two control groups showed no effects. This demonstrates that circulatory effects are the result of nicotine. The nicotine aerosol effects are so similar to those of cigarettes that the aerosol may provide a substitute for patients with respiratory disease who have difficulty giving up cigarettes.

HIESTAND W A, RAMSEY H J, HALE D M 282
 THE EFFECTS OF CIGARETTE SMOKING ON METABOLIC RATE, HEART RATE,
 OXYGEN PULSE, AND BREATHING RATE
 THE JOURNAL OF LABORATORY AND CLINICAL MEDICINE 25(10):1013-1017,
 1940

The immediate effects of cigarette smoking on metabolic rate, heart rate, oxygen pulse, and respiratory rate were determined in

subjects (n = 390; 18 males, 21 females) under nonbasal conditions following smoking 1 cigarette. Smoking 1 cigarette caused an increase in metabolic rate in 82% of the subjects, a decrease in 13%; and no immediate effects were observed in 5%. The average increase in metabolic rate was 8.9%. The average increase in metabolic rate for 18 men was 7.7%; for 21 women, 9.9%. The maximum effects of smoking 1 cigarette on basal metabolism was reached immediately in some subjects or delayed as long as 45 min in other subjects. Smoking caused an increase in heart rate in 72% of the subjects, a decrease in 26%, and no change was observed in 2.5%. After 15 min following smoking, the heart rate became slower than normal. Average increase in heart rate for men was 5.9%; for women, 6.4%. Rate of breathing decreased immediately after smoking and returned to normal 45 min later. Smoking caused an immediate decrease in the oxygen pulse rate followed by an increase lasting about 45 min. The greatest physiological changes were observed in habitual smokers who inhaled and by persons unaccustomed to smoking. More marked changes were seen in subjects in a basal metabolic condition than in persons in a nonbasal metabolic state.

HINMAN L M, STEVENS C A, MATTHAY R A, GEE B L 762
ELASTASE AND LYSOZYME ACTIVITIES IN HUMAN ALVEOLAR MACROPHAGES
AMERICAN REVIEW RESPIRATORY DISEASE 121:263-271, 1980

The elastase and lysozyme activities in alveolar macrophages were studied in 27 smokers and nonsmokers. Macrophages, particularly those in smokers, were found to synthesize a calcium-dependent activity against synthetic substrate which was distinct from polymorphonuclear leukocyte elastase. This activity was enhanced in smokers. Smokers' macrophages contained serine-proteinase activity that had an inhibitor profile similar to that of polymorphonuclear leukocyte elastase. The macrophages from smokers secreted 5 times more lysozyme and contained more lactate dehydrogenase activity than those of nonsmokers. These data show that polymorphonuclear elastase can become associated with the alveolar macrophage, which could assume a protective role against unrestrained elastinolysis.

HOIDAL J R, FOX R B, LEMARBE P O A, PERRI R, REPINE J E 763
ALTERED OXIDATIVE METABOLIC RESPONSES IN VITRO OF ALVEOLAR
MACROPHAGES FROM ASYMPTOMATIC CIGARETTE SMOKERS
AMERICAN REVIEW RESPIRATORY DISEASE 123:85-89, 1981

To evaluate the role of oxidants from alveolar macrophages on the development of emphysema, alterations in the oxidative metabolism of alveolar macrophages were studied in 51 nonsmokers and 32 smokers. The superoxide anion released in smokers was greater

than that from nonsmokers. This also occurred before and after stimulation by bacteria or phorbol myristate acetate. However, oxygen uptake and glucose (1-14 C) oxidation by unstimulated and stimulated alveolar macrophages from smokers was the same as that from nonsmokers. Because intracellular superoxide dismutase was increased in alveolar macrophages from smokers, the selective increase of superoxide anion release was not due to a lack of anion scavenging agent in the cells. The lysis of fibroblasts induced by alveolar macrophages from nonsmokers was completely prevented by addition of intracellular superoxide dismutase and catalase, confirming the importance of superoxide anion release.

HOPKINS R, WOOD L E, SINCLAIR N M 159
EVALUATION OF METHODS TO ESTIMATE CIGARETTE SMOKE UPTAKE
CLINICAL PHARMACOLOGY THERAPEUTICS 36(6):788-795, 1984

Following a 24-hour smoking abstinence period, six heavy smokers (25-37 yrs old) each smoked a single cigarette. The study revealed positive correlations between heart rate and blood plasma nicotine concentration increases and between percentage of carboxyhemoglobin and exhaled carbon monoxide. There was also an increase in mean levels of plasma cotinine levels with a peak concentration occurring approximately 1 hour after smoking. Urinary levels of nicotine, cotinine, and nicotine-1'-N-oxide and salivary and plasma levels of thiocyanate were effectively unchanged following smoking a single cigarette. Similarly, cigarette smoke generation and cigarette butt nicotine retention did not correlate well with other measures of smoke uptake. It is concluded that of the noninvasive procedures, heart rate and exhaled carbon monoxide are the most useful indices of smoke uptake. Of the invasive procedures, carboxyhemoglobin and plasma nicotine levels are the most useful indices of smoke uptake while plasma levels of cotinine and thiocyanate may be more useful for studying long-term smoking.

HORAN J J, HACKETT G, NICHOLAS W C, LINBERG S E, STONE C I,
LUKASKI H C 289
RAPID SMOKING: A CAUTIONARY NOTE
JOURNAL CONSULTING CLINICAL PSYCHOLOGY 45(3):341-343, 1977

Six subjects (3 males and 3 females, averaging 30.8 years of age) were monitored throughout sessions of a rapid-smoking treatment. Mean peak heart rate increases of 35 beats/min (range 77-112) were found. Blood pressures increased an average of 15 mm Hg systolic and 10 mm Hg diastolic (119/80 to 134/90). Carboxyhemoglobin levels were estimated at 7%-10%, based on samples of expired-air carbon monoxide. These changes are generally higher than those that have been reported previously. Six subjects

showed ECG abnormalities. One of the males, age 36, developed a second-degree heart block during three of the sessions after smoking rapidly. A 31-year-old female demonstrated depressed, horizontal S-T segments during and after rapid smoking. Total smoking time in each case was less than 10 min. S-T segment depression and T-wave inversion were observed within 1 min of rapid smoking.

HOUSTON J P, SCHNEIDER J P, JARVIK J E
EFFECTS OF SMOKING ON FREE RECALL AND ORGANIZATION
AMERICAN JOURNAL OF PSYCHIATRY 135:220-22, 1978

Twenty-three habitual smokers smoked either nicotine-free cigarettes or cigarettes containing a known amount of nicotine and were given three successive study-test trials on a 75-item free-recall list containing 15 instances of each of 5 categories. Two days later, subjects were tested for free recall of the list without additional study trials. Nicotine subjects recalled a mean of 24.64, 30.82, and 33.36 words on postsmoking trials 1, 2, and 3, respectively. Non-nicotine subjects recalled a mean of 30.66, 36.08, and 43.50 words on the same trials. The mean numbers of words recalled correctly in the second-session delayed test by the returning nicotine and non-nicotine subjects were 32.50 and 43.00, respectively. The study indicated that nicotine was associated with a decrement in both immediate and delayed retention and that the amount of organizational activity (indexed by clustering) did not parallel these results.

HUGHES J R, HATSUKAMI D K, PICKENS R W, KRAHN D, MALIN S,
LUKNIC A 148
EFFECT OF NICOTINE ON THE TOBACCO WITHDRAWAL SYNDROME
PSYCHOPHARMACOLOGY 83(1):82-87, 1984

Study tested the ability of nicotine to alleviate tobacco withdrawal syndrome. Signs and symptoms of tobacco withdrawal were measured in 100 smokers who fulfilled DSM-III criteria for tobacco dependence and a past history of tobacco withdrawal. After 2 baseline measurements, subjects were randomly assigned to receive either nicotine (2 mg) or placebo (spiced to match taste and irritancy of nicotine) gum in a double blind manner. Subjects then stopped smoking, chewed gum freely, and returned on days 1, 2, and 4 of abstinence for further measurement. Nicotine decreased the expected increase in irritability, anxiety, difficulty concentrating, restlessness, impatience, and somatic complaints that subjects reported after cessation. Reductions in these withdrawal symptoms by nicotine were confirmed by both self-report and Profile of Mood States questionnaire. Nicotine did not affect increases in cigarette craving, hunger, eating, insomnia, tremulousness, or supine heart rate after cessation.

HUGHES J R, HATSUKAMI D K, PICKENS R W, SVIKIS D S 142
 CONSISTENCY OF THE TOBACCO WITHDRAWAL SYNDROME
 ADDICTIVE BEHAVIORS 99:409-412, 1984

Cessation of smoking produces several signs and symptoms termed the tobacco withdrawal syndrome. Ten signs and symptoms of tobacco withdrawal syndrome were recorded; supine HR, orthostatic response, caloric intake, sleep, craving, irritability, anxiety, difficulty concentrating, drowsiness, and restlessness. A consistent change was defined as present when the sign or symptom occurred during first trial, returned to baseline, then recurred during second trial. A consistent change in all subjects occurred for HR, insomnia, caloric intake, irritability, restlessness and drowsiness. Orthostatic response, craving, difficulty concentrating, and anxiety did not occur consistently. Thus, of 30 tests of consistency, 23 showed consistent changes. The 2 total discomfort measures indicated that the intensity of withdrawal discomfort was similar across trials. When these variables are constant, the syndrome is similar across repeated periods of abstinence.

HUSAIN M K, FRANTZ A G, CIASROCHI F, ROBINSON A G 305
 NICOTINE-STIMULATED RELEASE OF NEUROPHYSIN AND VASOPRESSIN IN HUMANS
 JOURNAL CLINICAL ENDOCRINOLOGY, 41:1113-1117, 1975

Radioimmunoassays of vasopressin and nicotine-stimulated neurophysin were performed on samples taken from 14 subjects who smoked two cigarettes. For 10 subjects, both vasopressin and neurophysin levels increased during and after smoking; the other subjects showed no change in either vasopressin or neurophysin. In a retest, three subjects drank 90 ml of whiskey before smoking. This pretreatment with ethanol eliminated or blunted vasopressin and neurophysin increases. Thus, nicotine is a potent stimulus for both vasopressin and neurophysin in some normal individuals, and the release mechanisms for these two peptides are closely linked.

HUTCHINSON R R, EMLEY G S 522
 EFFECTS OF NICOTINE ON AVOIDANCE CONDITIONED SUPPRESSION AND AGGRESSION RESPONSE MEASURES IN ANIMALS AND MAN
 IN: SMOKING BEHAVIOR: MOTIVES AND INCENTIVES, DUNN W J, ED., WASHINGTON, DC, WINSTON AND SONS, 1973, PP. 171-196

This report includes a summary of two studies examining the relationship in humans between nicotine and jaw clenching, viewed as an index of irritability. In the first study of eight smokers

anticipating in a smoking withdrawal clinic, all but one subject showed an increased frequency of jaw contraction subsequent to quitting smoking, although this effect diminished over time. Subjects showed an increase in the duration of high-force jaw contractions after quitting smoking. In the second experiment, four nonsmokers were exposed to a tone for 2 seconds every 3 minutes. At those sessions at which they drank 5 mg of nicotine in water, they had fewer jaw contractions than when they had no nicotine. These results indicate that smoking is reinforcing and termination of smoking leads to irritability. These findings parallel results with other animals and suggest that intake of nicotine in a stressful environment is a reinforcing event and that termination of this habit is a negatively reinforcing event.

HYND G W, O'NEAL M, SEVERSON H H 288
 CARDIOVASCULAR STRESS DURING THE RAPID SMOKING PROCEDURE
 PSYCHOLOGICAL REPORTS 39:371-375, 1976

The subjects included 6 females and 4 males whose ages ranged from 21 to 48 yrs, with a mean of 27.8 yr. Heart rate (HR), blood pressure (BP), and peripheral skin temperature (as a measure of vasoconstriction) were measured. Mean temperature prior to smoking was 31.8 C, with an effect being noted during and immediately following the trial. Similarly, changes in HR were also significant with a mean heart rate of 78.8 beats/min being recorded previous to rapid smoking and a post measure of 85.9 beats/min following the procedure. Changes in BP, both systolic ($P < .05$) and diastolic, were increased, and indicated a reaction to stress. Each trial lasted, on the average, 5 min 43 sec, with a mean of 2.3 cigarettes being consumed per trial by each subject. Both systolic and diastolic blood pressure were elevated during and after the rapid-smoking trials with peripheral skin temperature being affected in a similar manner. Increase in skin temperature was due to increases in HR and BP, not vasoconstriction. Based on these results, the effects of the rapid smoking procedure were not large and may not imply any clinically significant danger.

IVEY K J, TRIGGS E J

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ABSORPTION OF NICOTINE BY THE HUMAN STOMACH AND ITS EFFECT ON
GASTRIC ION FLUXES AND POTENTIAL DIFFERENCES

AMERICAN JOURNAL DIGESTIVE DISEASES 23(9): 809-814, 1978

Effect of oral nicotine, i.v. nicotine, and cigarette smoking on ion fluxes and electrical potential difference in the human stomach was studied. Nicotine was well absorbed ($18.6\% \pm 3.4\%$) in 15 min, on intragastric administration at pH 9.8. Absorption was accompanied by side-effects of nausea and vomiting, and delay in gastric emptying. Gastric absorption of nicotine at pH 7.4 was $8.2\% \pm 2.9\%$; and at pH 1, $3.3\% \pm 1.4\%$. Rapid cigarette smoking and i.v. nicotine decreased gastric acid output. Neither oral administration, i.v. infusion (4 mg/hr of nicotine base), nor smoking 3-5 cigarettes per hour significantly altered the gastric mucosal barrier (as measured by gastric ionic fluxes and potential difference).

JACOBSON E 333
 MUSCULAR TENSION AND THE SMOKING OF CIGARETTES
 AMERICAN JOURNAL PSYCHOLOGY 56:559-574, 1943

The effects of smoking cigarettes on muscular tension were studied by recording microvoltages of the lower thigh before, during, and after smoking cigarettes. In some subjects, no consistent change of microvoltage was observed from preperiod to (smoking) mid-period; in some, an increase in microvoltage (increased muscular tension) occurred; in others, a decrease (muscular relaxation) occurred. In many subjects, this observed change was continued after smoking (postperiod). The same three sequential effects were also observed on smokeless days, though the first (no change of microvoltage) was more frequent than on the days when the subject smoked. In that third of the subjects who smoked the largest absolute voltages during the preperiod gain, as a group, a substantial average drop in potential occurred during the (smoking) mid-period. There is no evidence that this selective drop was due to direct physiological effects of nicotine or other ingredients breathed from the cigarette. The smoking of cigarettes produced no marked immediate effect on muscular tension under the conditions of this investigation.

JAIN A C, BOWYER A F, MARSHALL R J, ASATO H 481
 LEFT VENTRICULAR FUNCTION AFTER CIGARETTE SMOKING BY CHRONIC
 SMOKERS: COMPARISON OF NORMAL SUBJECTS AND PATIENTS WITH
 CORONARY DISEASE
 AMERICAN JOURNAL OF CARDIOLOGY 39:27-31, 1976

The effect of rapidly smoking two cigarettes on left ventricular function was studied in normal chronic smokers (35-51 yrs old) and those with coronary artery disease (38-56 yrs old). Results indicated an increase in heart rate for both normal and coronary artery disease subjects following smoking. Similarly, there was a slight increase in diastolic and systolic blood pressure following smoking. The preejection period remained the same or decreased slightly in normal subjects but increased in most diseased subjects following smoking. The ratio of preejection period to left ventricular ejection time diminished in normal subjects but increased in diseased subjects after smoking. Following smoking, there was a decrease of external isovolumetric contraction time in most normal subjects but an increase in diseased subjects. Thus, it is concluded that left ventricular function is impaired in subjects with significant coronary artery disease. Another potential contributing factor is carbon monoxide. Because of the reduced oxygen supply due to carboxyhemoglobin and the leftward shift in the oxyhemoglobin dissociation curve, there is a concomitant depression of myocardial function in chronic smokers with obstructive coronary lesions, but no such depression in normal subjects with greater coronary circulation.

JANIS I L, HOFFMAN D 199
 FACILITATING EFFECTS OF DAILY CONTACT BETWEEN PARTNERS WHO MAKE A
 DECISION TO CUT DOWN ON SMOKING
 JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY 17:(1) 25-35, 1971

Thirty smokers attending five weekly clinics were assigned to three different groups: daily contact between partners, contact between partners only at the clinic, absence of stable partners. Although all groups cut down smoking by the end of the clinic, after 1 year only the high-contact partners had sustained this success. The high-contact group developed more negative attitudes toward smoking, and post-clinic attitudes toward smoking were highly related to long-term success. By the end of the clinic, high-contact partners had lower anxiety scores than other subjects, liked their partners more, and expressed fewer dissatisfactions with the clinic. The long-term effect on smoking behavior occurred even though high-contact partners stopped talking to each other soon after the clinic ended. Thus, it seems likely that the interpersonal attraction fostered by daily contact during the clinic produced increased valuation of the clinic and internalization of the norms expressed by the clinic leader.

JANZON L 462
 THE ACUTE EFFECT OF SMOKING ON CALF BLOOD FLOW: A
 PLETHYSMOGRAPHIC STUDY IN HEAVY SMOKERS
 VASA 4(3):278-281, 1975

To study the acute effect of smoking on heart rate, blood pressure, and calf blood flow, 20 heavy smokers were examined before and after smoking two cigarettes. Blood pressure and heart rate increased after smoking, but calf blood flow and resistance to blood flow at rest did not change. During induced reactive hyperemia, resistance to blood flow decreased and blood flow increased. A control study performed without smoking showed no changes in blood flow or resistance to blood flow at rest or during reactive hyperemia. The acute effects of smoking on these measures of blood flow are probably induced by nicotine.

JANZON L, NILSSEN I M 44
 SMOKING AND FIBRINOLYSIS
 CIRCULATION 51:1120-1123, 1975

To study fibrinolytic activity of vein walls in smokers and nonsmokers, 71 heavy smokers (>1.5 g/day tobacco) and 41 nonsmokers were examined. After 12 hr abstention from tobacco, the

smokers had the same fibrinolytic activity as the nonsmokers. Of the 71 heavy smokers, 31 refrained from smoking during 8-9 weeks. Neither in those who had abstained nor in the controls did the fibrinolytic activity differ from that initially recorded. The effect of smoking six cigarettes during 3 hr was measured, and was associated with increased fibrinolytic activity in blood, measured as clot lysis time, and in superficial hand veins. This increase is probably due to the combined effect of nicotine and carbon monoxide.

JOHANSSON G, JANSSON G
SMOKING AND NIGHT DRIVING
SCANDINAVIAN JOURNAL PSYCHOLOGY 6:124-128, 1964

The subject viewed monocularly a weakly illuminated surface, the background, which subtended an angle of 15 degrees at the viewing eye. The luminance of this surface corresponded to that of a concrete road surface 30 m in front of a car with full headlights measured at eye level above the driver's seat. Five detection time measurements were made after allowing 1 min for adaptation to the light intensity of the apparatus. Ten redetection time measurements were made, these being separated by 1-min intervals to allow for readaptation. A few blind trials were inserted at random among these measurements, as a control of the reliability of the subject's reactions. In these trials, the glare occurred as usual without the signal being presented afterwards. Five more detection time measurements were made after allowing 1 min for adaptation. The difference between the smoking and non-smoking conditions was 0.15 sec for detection time and 0.08 sec for redetection time. In both cases, the time was greater for the smoking condition, but these differences did not prove to be significant. $P = 0.79$ for the detection time, and $P = 0.12$ for the redetection time. The conclusion is that the effect of tobacco smoking on the ability to detect objects on the road is from a practical point of view negligible.

JOHNSTON D M 313
A PRELIMINARY REPORT OF THE EFFECT OF SMOKING ON SIZE OF VISUAL FIELDS
LIFE SCIENCES 4:2215-2221, 1965

Visual field size was determined by psychophysical detection thresholds measured along four meridians (0 degrees, 90 degrees, 180 degrees, and 270 degrees) in one eye. One experimental group consisted of four heavy smokers who abstained from smoking for a 2-week period before testing. Another subject was a nonsmoker who smoked one pack of cigarettes per day for 2 weeks prior to

testing. Control Group I consisted of heavy smokers who continued to smoke at normal rates throughout the study. Control Group II consisted of nonsmokers who did not smoke during the study. For the experimental group that abstained from smoking for 2 weeks, visual field size for each subject increased 16%-85% with a mean percent change of 36%. Field size change for control groups ranged from 0%-5% with a mean change of 3% at the end of the 2 weeks. For two of the four subjects who had abstained from smoking, visual field size decreased markedly after resumption of smoking. (The other two smoking abstainers refused to resume smoking.) The size of the nonsmoker's visual field decreased 26% following the 2-week smoking period, although the smoke was not inhaled. It is concluded that smoking affects peripheral vision. Visual field examination should give consideration to the recency of smoking.

JOHNSTON D M 556
EFFECT OF SMOKING ON VISUAL SEARCH PERFORMANCE
PERCEPTUAL AND MOTOR SKILLS 22:619-622, 1966

The visual search performance of eight subjects was studied. The four subjects in the experimental group either quit or greatly decreased smoking for 2 weeks. There were two control groups of two subjects each, one group of smokers and one group of nonsmokers. These control groups were asked not to alter their smoking habits during the study. Search performance on acuity ring and silhouette displays was measured for all subjects before and after the 2-week period. Overall, the experimental group had a 34% improvement in performance. Control smokers had only a 6% improvement, and control nonsmokers had a 25% improvement. These results are consistent with results of previous studies showing that peripheral acuity affects search performance and smoking affects peripheral acuity.

JOYNER R E 334
EFFECT OF CIGARETTE SMOKING ON OLFACTORY ACUITY
ARCHIVES OTOLARYNGOLOGY 80:576-579, 1964

Ten serial dilutions of phenol crystals in liquid petrolatum were sniffed by subjects who indicated whether or not they smelled an odor. The subjects were rated by the number of vials correctly identified as containing phenol. The ratings were correlated with the average number of cigarettes smoked per day. Ratings decreased from 7.26 for nonsmokers, 7.22 for 10 cigarettes/day, 6.54 for 20 cigarettes/day, to 6.11 for 21 or more cigarette/day. Decreased olfactory acuity was associated with cigarette smoking. Decreased acuity and amount of smoking were correlated.

KALLMAN W M, KALLMAN M J, HARRY G J, WOODSON P P,
ROSECRANS J A 435
NICOTINE AS A DISCRIMINATIVE STIMULUS IN HUMAN SUBJECTS
IN: DRUG DISCRIMINATION: APPLICATIONS IN CNS PHARMACOLOGY,
AMSTERDAM, ELSEVIER, 1982, pp. 211-213

In this study, 22 male heavy smokers (20-45 yr old) discriminated between cigarettes equated for taste and draw factors but varying in nicotine levels. After 2 discrimination learning sessions, subjects were asked to discriminate between cigarettes with 0.69 or 0.28 mg nicotine/cigarette or between cigarettes with 1.30 or 0.14 mg nicotine/cigarette. Whereas 94% of subjects learned to discriminate between 1.30 and 0.14 mg nicotine in 4 trial sessions, only 27% learned to discriminate between 0.69 and 0.28 mg nicotine in 8 trial sessions. Differences in heart rate and finger skin temperature after smoking were not significant for the 4 nicotine levels. Subjects reported harshness in throat, dizziness, and change in heart rate as cues for discriminating pairs of cigarettes; however, the subjectively reported cues were not adequate measures for discrimination. The operant 2-level methodology used with animals was successful for testing discrimination properties of drugs in humans. Although humans discriminated widely discrepant nicotine doses by cigarette smoking, the mechanism for discrimination was not determined.

KANEKAR S, DOLKE A M 422
SMOKING EXTRAVERSION AND NEUROTICISM
PSYCHOLOGICAL REPORTS 26:384, 1970

The relationship of smoking to extroversion and neuroticism was measured by the Eysenck Personality Inventory in 4 groups of male Indian smokers and nonsmokers ($n = 25$ in each group, 25-35 yrs old). A significant difference was observed among the groups. There was a positive relationship between amount of smoking and degree of extroversion. The relationship between the amount of smoking and degree of neuroticism was negative. The correlation between extroversion and neuroticism was $-.21$. Results are consistent with Eysenck's theory of personality, that the amount of smoking is directly related to extroversion. Results indicate there is a complex relationship between smoking and neuroticism.

KAPLAN A R, GLANVILLE E V 256
TASTE THRESHOLDS FOR BITTERNESS AND CIGARETTE SMOKING
NATURE 202:1366, 1964

Taste thresholds of males and females ($n = 34$ smokers, 40 nonsmokers; 31-50 yrs of age) for quinine and 6-n-propylthiouracil (PROP) were determined. Each solution in the

concentration series was twice as concentrated as the next lower solution. Distilled water was used as a solvent, placebo, and a mouth rinse between solutions. Male smokers (mean threshold 7.8) were less sensitive to quinine than male nonsmokers (mean threshold 4.6). Female heavy smokers (mean threshold 7.2) were less sensitive to quinine than female nonsmokers (mean threshold 5.4). Taste sensitivity for PROP was lower in both male and female smokers than in nonsmokers. If results were grouped according to tasters and nontasters, subjects whose PROP taste threshold was 9 and below would be classified as tasters; with thresholds of 10 and above, classified as nontasters. Heavy male and female smokers included fewer tasters than the nonsmokers. A correlation exists between smoking habits and bitter taste thresholds. This relationship is greater and more significant in older people (ages 31-50) than in college age subjects.

KAY H W, KARPOVICH P V 604
EFFECT OF SMOKING UPON RECUPERATION FROM LOCAL MUSCULAR FATIGUE
RESEARCH QUARTERLY 20:250-256, 1949

In the present study, 14 college students who were habitual smokers tested the effect of cigarette smoking on the ability to recover from local muscular fatigue. Subjects squeezed a hand dynamometer at 10-sec intervals for 6 min, rested for 3 min, squeezed the hand dynamometer at 10-sec intervals for 4 min, rested for 5 min, and squeezed the hand dynamometer 3 final times. This sequence was repeated twice with each subject. Once, the subject smoked a cigarette in his usual manner during the 3 min rest period and the other time he smoked a placebo. Mean scores were calculated for all 14 subjects for each test. In the first test, no difference was obtained for smoking and nonsmoking. Dynamometer readings in the second series of tests were consistently higher than in the first series, and the degree of recovery after the 3 min rest was likewise greater. Smoking of 1 cigarette by habitual smokers had no effect on recovery from local fatigue of the flexors of the hand.

KERRIGAN R, JAIN A C, DOYLE J T 70
THE CIRCULATORY RESPONSE TO CIGARETTE SMOKING AT REST AND AFTER
EXERCISE
AMERICAN JOURNAL OF MEDICAL SCIENCES 255:113-119, 1968

The heart rate, blood pressure, and cardiac output were measured in 35 subjects, both smokers and nonsmokers while at rest, during bicycle ergometer exercise, after smoking two cigarettes, and again during exercise after smoking two more cigarettes. All indices were increased in both groups by external work. Smoking was associated in both groups with a small but consistent

increase in cardiac output. Compared with the nonsmokers, habitual smokers showed a consistent small and prolonged pressor response to smoking two cigarettes as well as a longer sustained increase in heart rate. The adverse effect of smoking on coronary disease may be due to the decreased efficiency by which work is done under the influence of tobacco, perhaps aggravated by the more prolonged pressor and tachycrotic responses of habitual smokers.

KERSHBAUM A, BELLET S, JIMENEZ J, FEINBERG L J 276
DIFFERENCES IN EFFECTS OF CIGAR AND CIGARETTE SMOKING ON
FREEFATTY ACID MOBILIZATION AND CATECHOLAMINE EXCRETION
JOURNAL AMERICAN MEDICAL ASSOCIATION 195(13):1095-1098, 1966

The effects of cigar and cigarette smoking on free fatty acid (FFA) mobilization and catecholamine excretion were determined in male subjects (n = 43, 21-46 yrs old). To obtain evidence of any difference in absorption of tobacco smoke, experiments were performed with tobacco impregnated with glucose tagged with radioactive carbon (C-14). A cigarette and segment of cigar (1 g) were injected in 50 uCi of C-14 and smoked in 10-min intervals on successive days by the same subject. To determine the effects of cigar and cigarette smoking on urinary catecholamine excretion, subjects (n = 11) smoked 4 cigarettes (4 g) or a cigar segment (4 g) within 1 hr. There was a greater increase in FFA concentration in the serum with cigarette than with cigar smoking. Inhaling caused a greater FFA response than not inhaling with both cigars and cigarettes. With tobacco containing glucose randomly labelled with C-14, there was a greater absorption of C-14 with cigarette smoking. Urinary catecholamine excretion increased during smoking, more with cigarettes than with cigars. This greater output is attributable to differences in smoke inhalation and nicotine absorption.

KERSHBAUM A, PAPPAJOHN D J, BELLET S, HIRABAYASHI M, SHAFIHA H 124
EFFECT OF SMOKING AND NICOTINE ON ADRENOCORTICAL SECRETION
JOURNAL OF AMERICAN MEDICAL ASSOCIATION 203(4):275-278, 1968

The influence of tobacco smoking and nicotine on adrenal cortex secretions was studied in nine humans and in animals. Blood samples from the human subjects showed a 27% to 77% rise in plasma 11-hydroxycorticosteroid concentrations after heavy cigarette smoking, compared to a normal daytime fall during control observations with no smoking. In dogs, intravenous doses of nicotine resulted in a 64% rise in plasma corticosteroids, and in rats a 58% rise. It is suggested that this rise in adrenocortical activity is due to enhanced corticotropin release resulting

from a nicotine-induced rise in sympathetic and catecholamine activity. In light of these results and the known relationship of smoking to atherosclerotic vascular disease, further investigation should be done to determine whether the adrenocortical effect of smoking is related to atherogenesis.

KLAUSEN K, ANDERSEN C, NANDRUP S 163
ACUTE EFFECTS OF CIGARETTE SMOKING AND INHALATION OF CARBON
MONOXIDE DURING MAXIMAL EXERCISE
EUROPEAN JOURNAL APPLIED PHYSIOLOGY, 5(3):371-379, 1983

Decreases in maximal oxygen uptake were significant for both the smoking and carbon monoxide inhalation conditions as compared to the control condition of no smoking and no carbon monoxide exposure prior to testing. Endurance time was decreased following both experimental conditions, but smoking had a greater effect. Increased maximal and resting heart rates were demonstrated for the smoking condition only. Lowered peak lactate concentration in the blood following maximal exercise was demonstrated for the smoking condition only. The results suggested that reduction of maximal blood oxygenation is the same for smoke as for carbon monoxide inhalation and that the reduction is due to blood/carbon monoxide saturation. On the other hand, the layer reduction in work capacity following smoking reveals that smoke components--perhaps nicotine--other than carbon monoxide influence endurance and heart rate. Finally, subjects who were more physically fit were less sensitive to the effects of smoking on maximal performance.

KOCH A, HOFFMAN K, STECK W, HORSCH A, ET AL. 50
ACUTE CARDIOVASCULAR REACTIONS AFTER CIGARETTE SMOKING
ATHEROSCLEROSIS 35:67-75, 1980

Cigarettes (n = 2) of high (1.54 mg) and low (0.08 mg) nicotine content were smoked and compared to sham smoking. The smoking procedure was standardized to provide inhalation of comparable amounts of smoke. After inhalation, there was a large increase in plasma nicotine followed by an exponential decrease. Plasma nicotine levels were elevated 2 hrs after smoking. After 2 low-nicotine cigarettes, there was a short-term increase with no change after sham smoking. HR paralleled the pattern of nicotine levels for all types of smoking. Increased HR and systolic BP, decreased pressure pulse transit time (PPTT) and digital blood flow were correlated with increasing nicotine levels. The increase in HR and systemic BP was probably due to beta-adrenergic action and decreased digital blood flow to alpha-adrenergic action. Beta-receptor predominance over alpha-receptors results in increased arterial muscle blood flow after high-nicotine

cigarettes. PPTT after high-nicotine cigarettes decreased immediately. The decrease in PPTT was less after a low-nicotine cigarette. Digital blood flow decreased after high nicotine cigarettes, low-nicotine cigarettes, and sham smoking. Carboxy-hemoglobin increased directly with a nicotine cigarette. Catecholamines from the adrenal medulla and other chromaffin tissues may mediate the responses to nicotine.

KOLLERSTROM N, LORD P W, WHIMSTER W F 742
A DIFFERENCE IN THE COMPOSITION OF BRONCHIAL MUCUS BETWEEN
SMOKERS AND NON-SMOKERS
THORAX 32:155-159, 1977

Fourteen left lungs were obtained post-mortem from seven smokers and seven nonsmokers to determine differences between these groups in the ratio of the amount of sulfated to sialidated mucin in the subepithelial mucous glands of the tracheobronchial tree. Both mucins were studied in histological sections stained by the high iron diamine/Alcian blue pH 2.5 sequence and assessed by a point-counting method. The sulfated to sialidated mucin ratio was determined in each generation of dichotomous branching beginning with the trachea (Generation 0) and continuing down through to the inferior lingular bronchial segmental pathway (Generation 8). Results indicated a lower ratio of sulfated to sialidated mucin in the nonsmokers. In addition, in both smokers and nonsmokers, there was a diminishing proportion of sulfated mucin down to the inferior lingular pathway from the trachea. Analysis of the logarithm of the ratio showed the smokers' means to be 2.3 times higher than that of nonsmokers at each generation of branching, and for both groups the ratio's average decrease down successive generations was given by a factor 0.9. It is concluded that the sulfated to sialidated ratio may be a sensitive measure of bronchial response to inhaled irritant, including cigarette smoke.

KOZLOWSKI L T, LEIMAN R M 013
EFFECTS OF ORAL pH ON CIGARETTE SMOKING
PHARMACOLOGY BIOCHEMISTRY BEHAVIOR, 9:477-480, 1978

Five 1-hr testing sessions were held. Sorenson's buffers were used. Blood pressure and heart rate were measured. Initial pH readings were taken from the dorsal surface of the tongue and inside cheek. Smokers were handed a lit cigarette and instructed to puff according to a series of taped commands (every 20 sec, a 2-sec puff). The cigarette was a Marlboro; the pH of the smoke was about 5.5. After 3 puffs, a pH reading was taken and a cigarette rating sheet was given. This was followed by a set of the 9 solution taste ratings. The spraying regimen, the pH

check, and the rating sheets were repeated 2 more times. As pH became more alkaline, subjects rated the cigarettes as stronger but not as more unpleasant. Heart rate increased to 83.90 beats/min at pH 8 compared to 83.8 beats/min at pH 5. Blood pressure was about the same at pH 5 and 8. The evidence indicated that oral pH affects cigarette taste ratings and heart rate.

KRIPPNER R 312
EFFECTS OF SMOKING ON PERIPHERAL VISUAL ACUITY
DISSERTATION ABSTRACTS 30:4395B, 1970

Ten habitual smokers smoked standard cigarettes preceding the first two peripheral vision tests, were deprived from smoking during the next 8 test sessions, and smoked again preceding the last 2 vision tests. A second group of 10 habitual smokers smoked standard cigarettes preceding the first two tests, smoked denicotinized cigarettes preceding the next 8 test sessions, and smoked standard cigarettes preceding the last 2 test sessions. Two control groups of 10 smokers and 10 nonsmokers smoked or did not smoke throughout all sessions. There was a difference in results between experimental and control groups. Abstinence from smoking increased the size of the visual field. After a period of abstinence, smoking decreased the size of the visual field. The major changes in peripheral vision were on the temporal meridian. Performance of the two experimental groups was identical, indicating that the effect of smoking on peripheral vision may be attributed to the nicotine component of the tobacco smoke.

KRONE P J, GOLDBARG A N, BALKOURA M, SCHUESSLER R,
RESNEKOV L 482
EFFECTS OF CIGARETTE SMOKING AT REST AND DURING EXERCISE. II:
ROLE OF VENOUS RETURN
JOURNAL APPLIED PHYSIOLOGY 32(6) 745-748, 1972

The cardiovascular response of healthy male smokers was measured during submaximal upright exercise (on a bicycle ergometer) before and after smoking a single cigarette. In contrast with previous studies, no leg bandages were used and there was no decrease in cardiac stroke index at moderately severe exercise before and after smoking. As in previous studies, heart rate was increased. These data indicate that cigarette smoking may contribute to an altered cardiovascular response during upright exercise through two separate mechanisms. Smoking appears to directly decrease peripheral venous return and to have a direct central action by increasing heart rate. It is concluded that the deleterious effects of cigarette smoking on endurance performance and physical training response in normal subjects (as

well as its impairment of tolerance to exertion in coronary heart disease patients) could result from these two separate effects of tobacco. By reducing venous return, smoking prevents attaining maximal stroke volumes and, therefore, impairs physical training effects.

KRUT L H, PERRIN M J 255
TASTE PERCEPTION IN SMOKERS AND NONSMOKERS
BRITISH MEDICAL JOURNAL 1:384-387, 1961

Two groups of subjects were tested to compare taste thresholds of smokers and nonsmokers and to determine the immediate effect of smoking a cigarette on taste thresholds. In both groups, smokers and nonsmokers showed no significant differences in mean thresholds for sweet, salt, or sour. The mean threshold for bitter was higher for smokers. This effect increased with the age of the smoker and thus, presumably, the duration of smoking and the amount smoked. Light smokers had a lower threshold for bitter than moderate and heavy smokers. Smoking of a cigarette had no immediate effect on taste perception. Ability to taste phenylthiocarbamide did not differ between smokers and nonsmokers. Therefore, the decreased acuity for bitter among smokers does not appear to have a genetic basis.

KUHN R A 592
MODE OF ACTION OF TOBACCO SMOKE INHALATION UPON THE CEREBRAL CIRCULATION
ANNALS NEW YORK ACADEMY OF SCIENCES 142:67-71, 1967

Retrograde brachial-cerebral angiography was used to study cerebral circulation of 20 habitual smokers before and after tobacco over-smoking. Tobacco smoke inhalation produced accelerated flow in the cerebral precapillary network and increased vessel counts. This effect appeared to be inversely related to age. CO₂ inhalation produces similar effects. It is not known which constituents of tobacco smoke are responsible for the effect.

KUMAR R, COOKE E C, LADER M H 67
IS NICOTINE IMPORTANT IN TOBACCO SMOKING?
CLINICAL PHARMACOLOGY THERAPEUTICS 21(5):520-529, 1977

The hypotheses that habitual smokers need nicotine and that they regulate their intakes of this drug were examined in two experiments. In the first experiment, doses of nicotine were given by inhalation of tobacco smoke. In the second experiment a month later, roughly comparable doses of nicotine were given to the

same subjects by intravenous injection. In the second experiment, the procedure for ad libitum puffing remained the same, but the doses of nicotine were administered by intravenous injections through a saline infusion which ran continuously into an arm vein. The dependent variable in both experiments was the amount and rate of ad libitum puffing at medium-strength, filter-tipped cigarettes (nicotine yield 1.3 mg) during the three 40-min sessions which followed each dose. Doses of inhaled tobacco smoke decreased. Linear dose trends were observed for the volume puffed, the number of puffs, and the volume per puff. In the second experiment, the doses of intravenous nicotine failed to affect the volumes puffed, the number of puffs, and the volume per puff. A study of the latencies of the first puff after the end of each dose showed that inhaled doses of smoke altered the latencies; intravenous doses were without effect. The average heart rates in the 10 min after the inhaled doses were 75.9, 77.2, and 79.3 beats/min for dose 0, 1, and 2, respectively; intravenous nicotine produced similar effects (73.5, 76.0, and 78.2 beats/min, respectively). Inhaled doses of nicotine were without a clear effect on any of the EEG bands, although there was a tendency for beta activity to be systematically increased by the drug both during and after the intravenous doses of nicotine. There was a trend in the infusion study for subjects to rate themselves more drowsy and relaxed as the experiment progressed; paradoxically they also reported feeling more energetic. It is concluded that these experiments do not support the nicotine-dependence hypothesis. The ways, if any, in which nicotine sustains the tobacco-smoking habit merit further examination.

LARSON P S, FINNEGAN J K, HAAG H B 336
OBSERVATIONS ON THE EFFECT OF CIGARETTE SMOKING ON THE FUSION
FREQUENCY OF FLICKER
29:483-485, 1950

Fusion frequency of flicker, defined as the highest number of impulses the retino-cortical system can perceive in a unit of time, was measured in 20 subjects under 6 smoking conditions with varying periods of abstinence preceding the experiment, and 1 nonsmoking (control condition). The first cigarette smoked after a period of abstinence caused an immediate temporary increase in the fusion frequency of flicker except when a low-nicotine cigarette (less than 0.2%) was used. This demonstrates that the elevation is due to the nicotine content of the cigarette tobacco. Continued smoking throughout the day had no depressant effect on fusion frequency of flicker.

LEIGH G, TONG J E, CAMPBELL J A 557
EFFECTS OF ETHANOL AND TOBACCO ON DIVIDED ATTENTION
JOURNAL OF STUDIES ON ALCOHOL 38(7): 1233-1239, 1977

The subjects received signals through earphones with each phone connected separately to a two-channel stereophonic audio tape recorder. One channel of the tape contained a series of bursts of random noise. The second channel contained a series of clicks. To measure changes over time, the scores from each block of trials were analyzed separately. There were no significant smoking or alcohol effects in block 1. Block 2 scores indicated an increased number of errors with alcohol, and an interaction between smoking and alcohol, in which fewer errors were made in the cigarette-placebo condition (2 vs. 1), but there were more errors in the cigarette-alcohol condition (4 vs. 3). Tone localization showed increased scores after alcohol and a significant interaction. Smoking can confound the results of alcohol experiments with human subjects to a degree not previously appreciated.

LEVINE P H 465
AN ACUTE EFFECT OF CIGARETTE SMOKING ON PLATELET FUNCTION
CIRCULATION 48:619-623, 1973

The effect of smoking cigarettes of varying nicotine contents on platelet aggregation and plasma free fatty acids (FFA) was studied. After baseline measurements were made, each subject smoked a cigarette, and another series of measurements was made at 10-min intervals. After 30-60 minutes, a second cigarette was smoked and a third series of measurements was made. In 11 smokers, no significant difference was found in mean platelet aggregation responses measured 10 and 20 min before and after

smoking the lettuce leaf cigarette. Similar studies performed the same day in the same 11 subjects before and after smoking the standard cigarette showed an increase in aggregation following standard smoking compared to the change in aggregation after lettuce leaf cigarette smoking. None of the 11 subjects developed an increase in FFA after the lettuce leaf cigarette. After the standard cigarette, all 11 developed increased FFA. The mean rise was 134 mg% from a mean baseline level of 556 mg%. The time of maximal FFA rise was 30 min after smoking. The degree of increment in FFA for individual subjects did not correlate with the degree of enhancement of aggregation. In three subjects, the rise in FFA occurred only after the increase in aggregation was noted. The data suggest a possible direct causal link between cigarette smoking and arterial thrombotic disease. The results may also help to explain the mechanism by which smoking accelerates atherosclerosis.

LINDBERG S E 868
RAPID-SMOKING TREATMENT FOR CIGARETTE ADDICTION: PHYSIOLOGICAL EFFECTS IN RELATION TO AGE AND CIGARETTE NICOTINE CONTENT
DISSERTATION ABSTRACTS INTERNATIONAL 39(4-B):1648B-1649B, 1978

Rapid smoking resulted in an increase in heart rate, substantial decrease in skin finger temperature, increase in carboxyhemoglobin values (1.1%-2.9%), and increase in end-tidal carbon monoxide values when compared with rapid breathing (simulated rapid smoking) and casual smoking. Systolic and diastolic blood pressure increased above rapid breathing values during rapid smoking in all groups; but differences in systolic pressure were only in groups YPM and OC. Diastolic pressure differences were significant only in group OC during casual smoking. A significant number of side-effects due to rapid smoking (nausea and vomiting) occurred in group YPM. ST segmental depression on an electrocardiogram was detected in 2 women in group YPM, 1 woman in group YC, and 1 woman in group OC during rapid smoking. Low-nicotine cigarettes are advised for older subjects who request rapid smoking treatment for relief from cigarette addiction; greater risk is assumed because of the progressive nature of heart disease.

LLOYD J A, ANDERSON W H 801
EFFECT OF CIGARETTE SMOKE ON CLOSING VOLUME
AMERICAN REVIEW RESPIRATORY DISEASES 109(6):725, 1974

Pulmonary closing volume (CV) of 50 smokers was determined before and 3, 5, and 7 minutes after smoking a cigarette. All but one subject showed an increase in CV after smoking that was evident even 7 minutes after smoking. The response of CV to smoking did

not correlate with amount of tar or nicotine, the way the subject smoked the cigarette, presmoking CV, maximal voluntary ventilation, or clinical diagnosis. These results indicate that reactivity of the small airways to cigarette smoke inhalation may be a nonspecific response to a respiratory tract irritant.

LUCCHESI B R, SCHUSTER C R, EMLEY G S 127
 THE ROLE OF NICOTINE AS A DETERMINANT OF CIGARETTE SMOKING
 FREQUENCY IN MAN WITH OBSERVATION OF CERTAIN CARDIOVASCULAR
 EFFECTS ASSOCIATED WITH THE TOBACCO ALKALOID
 CLINICAL PHARMACOLOGY AND THERAPEUTICS 8(6):789-796, 1967

Studies used i.v. administration of either physiological saline (0.91% NaCl) or nicotine bitartrate (22 mg/6 hr) with subjects unaware of nicotine infusion in a soundproof, air-conditioned cubicle. Heart rate (HR) increased from 72 \pm 3.3 bpm when not smoking (at rest) to 84 \pm 2.8 bpm during i.v. nicotine (22 mg/6 hr); this increase was not different from that in saline infused controls (HR = 84 \pm 2.9 bpm). Additional nicotine (2 mg) increased mean HR to 88 \pm 2.9 bpm. The additional administration of nicotine by i.v. infusion did not increase HR above that produced by smoking alone. Systolic blood pressure (BP) increased after smoking regardless of whether saline or nicotine was being infused. The diastolic BP increased less than the systolic BP, indicating increased pulse pressure.

LUCKE C, HERTING T 813
 THE EFFECT OF GANGLIONIC STIMULATING AGENTS ON THE SECRETION OF
 VASOPRESSIN IN HEALTHY PERSONS AND IN PATIENTS WITH DIABETES
 INSIPIDUS
 ACTA ENDOCRINOLOGY SUPPLEMENT 212:157, 1977

The effect of ganglionic stimulating agents on the secretion of vasopressin (VP) in healthy persons and in patients with diabetes insipidus (DI) was studied. Following smoking of two strong filterless cigarettes, VP levels increased in nine nonsmokers. Three patients with DI showed minimal or no increase. (3 mg) of Lobeline was injected into eight normal volunteers. Peak levels were always observed 3 or 6 minutes following injection. A second peak was observed in 6 of the volunteers after 30 minutes. While excessive VP levels are seen in nonsmokers, this test was found to be unreliable in smokers. Stimulation with Lobeline seems to be promising due to its lack of discomfort, speed of test results, and the facility with which the test can be performed.

LUDBROOK L, VINCENT A H, WALSH J A 564
 THE EFFECTS OF SHAM SMOKING AND TOBACCO SMOKING ON HAND BLOOD
 FLOW
 AUSTRALIAN JOURNAL EXPERIMENTAL BIOLOGICAL MEDICAL SCIENCE
 52(2):285-290, 1974

Changes in hand blood flow induced by sham smoking and tobacco smoking were studied in 15 smokers. The analysis took into account intra- and intersubject variance, as well as the transient decrease in hand blood flow following inhalation. Data were collected for two local hand temperatures, 26 and 36 degrees, and two inhalation rates; 1/minute and 3/minute. Sham smoking did not induce change in blood flow. At both temperatures and at both rates of inhalation, tobacco smoking induced a decrease in blood flow that lasted into the postsmoking period. Rate of inhalation did not affect this decrease. Tachycardia was induced by tobacco smoking but not by sham smoking. Thus, tobacco smoke has a specific effect even at the usual inhalation rate of 1/minute.

LUDBROOK J, WALSH J A, VINCENT A H 132
 THE EFFECTS OF TOBACCO SMOKING INTRAVENOUS NICOTINE AND OTHER
 PROCEDURES ON THE RESPONSE OF HAND BLOOD FLOW TO DISTANT ICE
 APPLICATION
 AUSTRALIAN JOURNAL EXPERIMENTAL BIOLOGICAL MEDICAL SCIENCE 52(2):
 291-300, 1974

The response of hand blood flow to ice application to the neck was studied during smoking, sham smoking, intravenous nicotine, a foot movement procedure, mental arithmetic, and imaginary smoking. With smoking or sham smoking, the ice response was depressed compared with resting conditions, i.e., there was less vasoconstriction at all levels of flow in response to ice application. Heart rate increased. Heart rate remained unchanged during sham smoking. In the second experiment, the effects of intravenous nicotine on the ice response were studied in four normal subjects. Nicotine hydrogen tartrate in 0.9% w/v saline was administered into an antecubital vein and ice responses were measured. Compared with controls during saline infusion, there was a reduction of the vasoconstriction induced by ice application during nicotine infusion (56% and 31%, respectively). Arterial blood pressure by the end of the 10-min nicotine infusion, and heart rate increased. In the third experiment, sham smoking and intermittent foot movement were studied to determine the effect of a procedure requiring the subject to respond to sensory input. Foot movement decreased the ice response compared with the control period, as did sham smoking. Ice application caused a 54% reduction in hand blood flow in the control condition, compared with 40% during sham smoking and 41% during foot movement. There was no difference between the effects of foot

movement and sham smoking on the ice responses. There was no change in heart rate increase during sham smoking and heart rate decrease during foot movement. In the fourth experiment, the effects of two procedures requiring cortical activity, i.e., mental arithmetic and imaginary smoking, were studied in 10 habitual smokers. Mental arithmetic reduced the ice response, while imaginary smoking had no effect. Ice application caused a 63% reduction in hand blood flow in the control condition, 71% during imaginary smoking, and 43% during mental arithmetic. Heart rate increased during mental arithmetic, but during imaginary smoking the increase was not significant. Results suggest that the effects of tobacco smoking on hand blood flow are not likely to have deleterious consequences because other stimuli of everyday life have at least as great an effect on hand blood flow as smoking at a tolerable level. It is concluded that cigarette smoking and intravenous nicotine increase the rate of tonic sympathetic discharge to the skin of the hand, but paradoxically inhibit the reflex discharge caused by ice application. Since all of the procedures except imaginary smoking reduced the ice response, a central inhibiting action, possibly at the cortical level, is postulated.

LUKAS S E, JASINSKI D R 851
 EEG POWER SPECTRAL EFFECTS OF INTRAVENOUS NICOTINE ADMINISTRATION
 IN HUMANS
 FEDERATION PROCEEDINGS 3:108, 1983

To obtain EEG correlates of previously reported nicotine-induced euphoric responses, male volunteers prepared with nine scalp electrodes were given i.v. injections of saline, and 3.0 mg of nicotine tartrate at hourly intervals. With eyes closed, the subjects were to press a button which activated an event marker if experiencing "euphoria." A 10 to 20 second initial dysphoric response was followed by paroxysmal episodes of euphoria with all doses of nicotine but not saline. In general, nicotine caused a dose-related decrease in total EEG power which was due to a 50% decrease in alpha power. These results indicate that a nicotine-induced subjective state is associated with characteristic EEG patterns and suggests that these phenomena might serve as a means to investigate the physiology of drug-induced subjective states.

LURJA S M, MC KAY C L 357
 VISUAL PROGRESS OF SMOKERS AND NONSMOKERS AT DIFFERENT AGES
 DTIC TECHNICAL REPORT NO. AD/A 082277, 1979

Forty smokers and forty nonsmokers matched for age took a battery of tests to assess whether habitual smoking affects vision and whether such effects increase with age. Smokers were worse than

nonsmokers in scotopic sensitivity. Also, smokers tended to need more positive correction to focus on near targets and to have poorer simple and choice reaction times. There were no differences on the perimetric test of color detection or in EEGs, and no significant changes in the visually evoked response to either 1 or 16 flashes per second. Differences between smokers and nonsmokers did not increase with age.

LYON R J, TING J E, LEIGH G, CLARE G 22
 THE INFLUENCE OF ALCOHOL AND TOBACCO ON THE COMPONENTS OF CHOICE
 REACTION TIME
 JOURNAL OF STUDIES ON ALCOHOL 36(5):587-596, 1975

Male students (20-25 years old, n = 16) were divided into smokers and nonsmokers. Choice reaction-time (CRT) tasks were measured. Latency between stimulus onset and removal of the finger from the resting key was termed "decision time." The period between removal of the finger from the resting key and depression of a response key was termed "motor time." Tobacco had a significant effect in lowering decision time scores when taken after alcohol. Stimulant effects of nicotine were found in the low and moderate alcohol dose groups (in comparing smokers smoking with smokers deprived and nonsmokers). No depressant effect of moderate dose of alcohol was shown in the smokers whether smoking or not, although it was shown in the nonsmokers. The apparent stimulant effect of a small dose of alcohol on decision time was very pronounced in the smokers. The major factor in cigarettes leading to this synergistic action is nicotine, rather than CO, CO₂, or hydrocarbons.

MANGAN G L

168

THE EFFECTS OF CIGARETTE SMOKING ON VERBAL LEARNING AND RETENTION
JOURNAL GENERAL PSYCHOLOGY 108:203-210, 1983

This experiment examined the effects of smoking on two verbal learning tasks. Subjects were 24 male smokers who either did not smoke, smoked a cigarette delivering 0.7 mg of nicotine, or smoked a cigarette delivering 1.3 mg of nicotine. On a paired-associate learning task, the interaction between nicotine level and task difficulty was marginally significant. The larger dose of nicotine impeded learning under low-interference conditions but facilitated learning under high-interference conditions. Both levels of nicotine improve retention, irrespective of task difficulty. Results from a serial learning task indicated that smoking facilitates long-term, not short-term, memory. The reasons for the interaction between dosage and task difficulty in paired associate learning are unclear.

MANGAN G L, GOLDING J F

170

THE EFFECTS OF SMOKING ON MEMORY CONSOLIDATION
JOURNAL PSYCHOLOGY 115:65-77, 1983

The effects of posttrial cigarette smoking on the postacquisition stage of learning were studied in 69 subjects. Ten words for the paired-associate learning task, with low associations within and between pairs, were presented to subjects on a memory drum every 3 sec. Immediately after, each smoker in the low-, medium-, and high-nicotine groups smoked a cigarette with the appropriate nicotine content. Tests of recall were made after one-half hour, 11 days, 1 week, and one month. For the trials to criterion analysis, on the one-half hour retest, the non-smoking group scored higher than the other groups; the 1-day retest higher than deprived and middle-nicotine smokers; and the 1-wk retest higher than the deprived, middle-, and high-nicotine groups but not the low-nicotine group, which scored higher than the middle- and high-nicotine groups. For the initial errors analysis, on the one-half retest nonsmokers had fewer errors than the deprived, low-, middle-, and high-nicotine groups. On the 1-day retest, differences between groups were few, but the low-nicotine group showed improvement compared with deprived and high-nicotine smokers. On the 1-wk retest, nonsmokers had fewer errors than the deprived and high-nicotine groups, as did the low- and middle-nicotine groups. Although nonsmokers scored higher than the other groups for the trials to criterion analysis, nonsmokers and high-nicotine smokers made more errors than the combined low/middle-nicotine group.

MARTIN R R 761
 ALTERED MORPHOLOGY AND INCREASED ACID HYDROLASE CONTENT OF
 PULMONARY MACROPHAGES FROM CIGARETTE SMOKERS
 AMERICAN REVIEW RESPIRATORY DISEASE 107:596-601, 1973

Alveolar macrophages from 11 smokers and 13 nonsmokers were studied for altered morphology and increased acid hydrolase content. Crystalloid, refractile cytoplasmic inclusions of autofluorescent material were found in fewer than 5% of macrophages from nonsmokers by 30% to 95% from smokers contained this material. Multinucleated giant cells were found in the lavage of 3 smokers. Macrophages from smokers had acid hydrolase concentrations that were increased as much as 6 times normal. These increases correlated with the amount of daily cigarette consumption. The increased acid hydrolase concentrations in cells from smokers indicate a mechanism by which chronic pulmonary disease may be related to smoking.

MASON G R, USZLER J M, EFFROS R M, REID E 753
 RAPIDLY REVERSIBLE ALTERATIONS OF PULMONARY EPITHELIAL
 PERMEABILITY INDUCED BY SMOKING
 CHEST 83(1):6-11, 1983

In order to evaluate the permeability of the pulmonary epithelium in smokers and nonsmokers, a radioaerosol procedure using ^{99m}Tc -DTPA was used. The clearance of ^{99m}Tc -DTPA among smokers was studied during and after smoking in 10 subjects with a scintillation camera to evaluate the rate and uniformity of solute clearance from the lungs. The average clearance from the lungs of smokers with no significant airway obstruction was greater than that found in normal subjects by an average factor of more than 5. This abnormality was observed in all lung regions. Clearance decreased rapidly in the week after smoking was stopped. These data indicate that smoking results in a rapidly reversible increase in pulmonary epithelial permeability.

MATSUBARA I, SANO T 565
 EFFECT OF CIGARETTE SMOKING ON HUMAN PRECAPILLARY SPHINCTERS
 BRITISH JOURNAL PHARMACOLOGY 45:13-20, 1972

The purpose of this experiment was to determine the effect of smoking on precapillary sphincters. The following measures were determined for four smokers before and after smoking: calf blood flow, capillary filtration coefficient of the calf, and venous pressure-volume curve of the calf. When subjects inhaled normally once per minute for 12 to 15 minutes, no vascular responses

were evident. When smokers inhaled deeply every 30 seconds for the same amount of time, some of the measures showed changes. Calf blood flow and the capillary filtration coefficient decreased. Thus, the venous system showed little effect of smoking, but arterioles constricted and precapillary sphincters closed as a result of smoking. It seems likely that release of norepinephrine is responsible for both effects.

MAYKOSKI K A, RUBIN M B, DAY S A C 797
EFFECT OF CIGARETTE SMOKING ON POSTURAL MUSCLE TREMOR
FEDERATION PROCEEDINGS 33(3 PT 1):361, 1974

This study was designed to determine the effect of smoking on postural muscle tremor. Amplitude and frequency of tremor were measured in 30 subjects. Although smoking one cigarette did not significantly affect frequency, amplitude was increased immediately and one-half hour after smoking. The findings indicate that smoking does affect the postural reflexes, perhaps through the action of released catecholamine on the servoloop mechanism.

MC CARTHY D S, CARIG D B, CHERNIACK R M 571
THE EFFECT OF ACUTE INTENSIVE CIGARETTE SMOKING ON MAXIMAL
EXPIRATORY FLOWS AND THE SINGLE-BREATH NITROGEN WITHOUT TRACE
AMERICAN REVIEW RESPIRATORY DISEASE 113:301-304, 1976

Eighty-two smokers attending a smoking cessation clinic inhaled cigarettes deeply until unable to continue. Forced vital capacity, forced expiratory volume in 1 second, peak expiratory flow, and slow vital capacity all decreased, and the slope of Phase III of the N₂ washout curve increased. For 52 subjects who reduced or stopped smoking, measurements were also taken six to nine months later. Peak flow, forced expiratory volume in 1 second, and the slope of Phase III showed improvement. Thus, intensive smoking is associated with a reduction in effort-dependent tests and with altered gas mixing in the lung. Resistance to air flow in the larger airways or reduction in effort and increased non-uniformity of intraregional distribution of ventilation is associated with acute intensive cigarette smoking.

MC DONOUGH J R, HAMES C G, GARRISON G E, 448
STULB S C, LICHTMAN M A, HEFELFINGER D C
THE RELATIONSHIP OF HEMATOCRIT TO CARDIOVASCULAR STATES OF HEALTH
IN THE NEGRO AND WHITE POPULATION OF EVANS COUNTY GEORGIA
JOURNAL CHRONIC DISEASES 18, 243-257, 1965

This study of the relationship between hematocrit and several variables associated with cardiovascular states of health included an analysis of the relationship between hematocrit and

smoking in a large sample of persons aged 40 to 74. For each race-sex group (Negro males, white males, Negro females, white females), hematocrit was higher among smokers than nonsmokers. These results support findings from a previous study.

MC HENRY P L, FARIS J V, JORDAN J W, MORRIS S N 674
COMPARATIVE STUDY OF CARDIOVASCULAR FUNCTION AND VENTRICULAR
PREMATURE COMPLEXES IN SMOKERS AND NONSMOKERS DURING MAXIMAL
TREADMILL EXERCISE
AMERICAN JOURNAL OF CARDIOLOGY 39:493-498, 1977

A comparative study was conducted of cardiovascular function and ventricular premature complexes (VPCs) in 586 men undergoing maximal treadmill exercise tests. The subjects were grouped according to smoking experience and further categorized according to age and pack-years of exposure. No significant differences were found in the prevalence of exercise-induced VPCs when current smokers were compared with nonsmokers or former smokers. The duration of maximal exercise was shorter in smokers and former smokers than in nonsmokers. Maximal heart rate during exercise was decreased in smokers and former smokers than in nonsmokers. Results indicate that the prevalence of exercise-induced VPCs did not appear to be influenced by smoking habits.

MERTENS H W, MCKENZIE J M, HIGGINS E A 374
SOME EFFECTS OF SMOKING WITHDRAWAL ON COMPLEX PERFORMANCE AND
PHYSIOLOGICAL RESPONSES
DTIC TECHNICAL REPORT NO. AD/A126557, 1983

Effects of smoking withdrawal on time-shared performance and physiological responses were determined at a simulated aircraft cabin altitude of 6,500 ft in male and female subjects (n = 17, 23-59 yrs old). Subjects performed the following tasks: monitoring, tracking, mental arithmetic, and problem solving during two 4 hr sessions; 1 in which smoking was permitted at half-hr intervals and a nonsmoking session. Carboxyhemoglobin concentrations were lower in the no-smoking condition than in the smoking condition; measurements taken 120 min after the experiment began were significant. No statistically significant effects of withdrawal for excretion rates of urinary hormones or urine volume were observed. When subjects smoked, heart rate increased. Overall composite performance scores showed decreases during withdrawal beginning at the third half-hr period. During withdrawal there was a decrease in tracking and a tendency toward increased reaction times in 1 monitoring task. During withdrawal performance decreases were associated with lower heart rate and lower attentiveness ratings. Findings support a cautious approach to the prohibition of smoking on the flight deck for aircrew members.

MILGROM-FRIEDMAN J, PENMAN R, MEARES R 156
 A PRELIMINARY STUDY ON PAIN PERCEPTION AND TOBACCO SMOKING
 CLINICAL AND EXPERIMENTAL PHARMACOLOGY AND PHYSIOLOGY 10:161-169,
 1983

The relationship between smoking and pain perception was studied by comparing the pain thresholds, tolerances, and qualitative pain experiences. Pain was applied by draining the blood from the arm with a rubber bandage which was not removed until a blood pressure cuff was inflated above systolic pressure. Pain estimates were made when a recorded tone sounded at random intervals, as well as when first pain was felt regardless of a tone. Subjects completed part two of the McGill pain questionnaire with 20 categories divided into sensory, affective, evaluative, and miscellaneous sub-scales. Deprived smokers and nonsmokers had the shortest mean time to pain onset. The longer smokers were deprived of cigarettes, the longer the time to onset. Because the nicotine gum group fit with the smokers as well as the deprived smokers subgroups, it seems that the deprivation of tobacco smoking, not nicotine, affects the time to onset. Smokers had the shortest mean tolerance time, which was different from nonsmokers, and the deprived smokers had a decreasing rate of pain increase as deprivation increased. The nicotine gum group was ranked in the middle. For the questionnaire, smokers and the 1-hour deprived group rated their experience as the most complex and severe. The nicotine gum and 12-hour deprived groups ranked at the opposite end; and nonsmokers in the middle. This indicated that cigarette deprivation decreases smoker's awareness of pain below that of smokers, whereas smoking cigarettes, rather than just absorbing nicotine, heightens awareness to a level equal to or above that of smokers.

MILLER L G, GOLDSTEIN G, MURPHY M, GINNS L C 759
 REVERSIBLE ALTERATIONS IN IMMUNOREGULATORY T CELLS IN SMOKING
 CHEST 82(5):526-529, 1982

To determine if alterations of immunoregulatory T cells occur in cigarette smokers, the circulating T-lymphocytes of 95 smokers and nonsmokers were analyzed. The total T-lymphocytes and T cell subsets found in light and moderate smokers were similar to those found in smokers. In heavy smokers, total OKT3+ cells increased, the percentage of OKT4+ cells decreased, and the percentage and total of OKT8+ cells increased. Furthermore, the ratio of OKT4+ to OKT8+ lymphocytes decreased in heavy smokers. After heavy smokers stopped smoking, the percentage of OKT8+ cells and the OKT4+/OKT8+ ratio returned to normal. This indicates that cigarette smoking causes reversible changes in immunoregulatory T cells.

MIYASATO K, HENNINGFIELD J E, JASINSKI D R 871
 PHYSIOLOGIC AND SUBJECTIVE EFFECTS PRODUCED BY NICOTINE WITH AND
 WITHOUT MECAMYLAMINE PRETREATMENT IN HUMANS
 FEDERATION PROCEEDINGS 41(4): 1223, 1982

Physiologic and subjective effects of nicotine with and without mecamylamine pretreatment were studied (using a double blind and latin square design) in cigarette smokers. Pupil diameter and skin temperature were recorded at 5 sec intervals from 3 min before to 6 min following each test dose of nicotine or saline. Subjective effects were measured by questionnaires given before and after each physiologic test sequence. Nicotine (0.75, 1.5, and 3.0 mg; i.v.) or saline administered at 1 hr intervals for 4 hr caused dose-related decreases in pupil diameter and skin temperature and subjective effects similar to those produced by psychomotor stimulants. Mecamylamine (2.5, 5.0, and 10 mg, p.o.) administered 1 hr before the 4 hr nicotine sequence produced a dose-dependent blockade of the physiologic and subjective effects of nicotine. It is concluded that effects of nicotine on pupil diameter, skin temperature, and subjective response are due to central cholinergic mechanisms.

MIYAZAKI M 802
 CIRCULATORY EFFECT OF CIGARETTE SMOKING WITH SPECIAL REFERENCE TO
 THE EFFECT ON GENERAL HEMODYNAMICS
 JAPANESE CIRCULATION JOURNAL 33(9):907-912, 1969

This study investigated the effect of smoking on cerebral hemodynamics, blood pressure, and heart rate. Subjects were four normal young men and eight men over 60 years old with either bronchial asthma or coronary insufficiency. All subjects were smokers. Smoking at an ordinary speed increased cerebral blood flow and decreased cerebral vascular resistance in all subjects after one to three inhalations. Rapid smoking changed these measures even more than ordinary smoking. With ordinary smoking, blood pressure and heart rate either did not change or slightly increased. Rapid smoking increased these measures conspicuously. Because cerebral hemodynamics and blood pressure were not correlated in ordinary smoking, it is suggested that tobacco has a specific effect on cerebral hemodynamics mainly due to the direct effect of nicotine.

MORGAN S F, PICKENS R W 106
 REACTION TIME PERFORMANCE AS A FUNCTION OF CIGARETTE SMOKING
 PROCEDURE
 PSYCHOPHARMACOLOGY 77:383-386, 1982

A test was developed to measure reaction time performance after varied smoking procedures: ad libitum own brand; ad libitum standard brand; standard brand per set pattern. The test

required matching a randomly selected lighted color button to various auditory tones. Subjects were tested during 3 sessions lasting 45 min over a 1-week period. Results showed that the performance of subjects was significantly slower after ad libitum smoking of own cigarette than after both ad libitum and controlled smoking of the standard cigarette.

MOSES D C, POWERS D, SOLOFF L A 488
GLUCOSE BLOCKAGE OF THE INCREASE IN STROKE VOLUME PRODUCED BY
SMOKING
CIRCULATION 29:820-824, 1964

Percentage changes in cardiac output, stroke volume, and heart rate were determined in 7 healthy habitual smokers after smoking, after glucose, and after smoking preceded by glucose. Each subject acted as his own control. No changes occurred after glucose. There was an increase in cardiac output, stroke volume, and heart rate after smoking. Pretreatment with glucose did not change the heart-rate response to smoking, but the cardiac-output response was diminished. This decrease is due to a block in the increase in stroke volume induced by smoking.

MOTLEY H L, KUZMAN W J 579
CIGARETTE SMOKE: ITS EFFECT ON PULMONARY FUNCTION MEASUREMENTS
CALIFORNIA MEDICINE 88:211-220, 1958

Spirogram recordings measured total vital capacity, the timed vital capacity for 3 sec, and the maximal breathing capacity. There was a slight increase in heart rate, but no significant change in respiratory rate. In one subject at rest there was a decrease (6.5%) in arterial blood oxygen saturation after smoking. This subject had severe emphysema, and following smoking, heart rate, respiration rate, and minute ventilation were significantly increased, but arterial pO₂ was decreased from 73.5 to 56.1 mm Hg. There was no significant change in arterial blood oxygen saturations before and after smoking either in the nonemphysema group or in the group with a moderate degree of emphysema. However, in the severe emphysema group there was an average decrease in arterial blood oxygen saturation from 90.7% at rest to 88.6% after smoking. In none of three groups of subjects with varying degrees of emphysema was there change in arterial blood oxygen saturation. Nor was there correlation between change in arterial blood oxygen saturation after smoking and residual percent of total lung capacity. There was no change in arterial CO₂ content and pH, before and after smoking with step-up exercise.

MOYER C A, MADDOCK W G 875
 PERIPHERAL VASOSPASM FROM TOBACCO
 ARCHIVES OF SURGERY 40:277-285, 1940

The effect of smoking on the vascular system was studied in 20 normal subjects by measuring skin temperature. In all cases, cutaneous temperature decreased progressively and blood pressure and heart rate increased shortly after smoking started and after cessation. There was no significant variation in the responses of heavy and light smokers. To determine if the rate, rhythm, and depth of breathing had affected results, subjects performed smoking movements on a paper tube or pipe. All changes were negligible. When smoke was filtered, cardiovascular changes occurred but to a lesser degree. In two subjects with thromboangiitis obliterans, the cutaneous temperature of the toes showed marked reduction when a cigarette was smoked. Intravenously administered nicotine induced results remarkably similar to those noted for smoking 1 cigarette. Results show that nicotine produces peripheral vasospasm.

MURPHEE H B, PFEIFFER C C, PRICE L M 517
 ELECTROENCEPHALOGRAPHIC CHANGES IN MAN FOLLOWING SMOKING
 ANNALS NEW YORK ACADEMY SCIENCE 142:245-260, 1967

Quantitative electroencephalographic (EEG) effects of smoking were reported for smokers and nonsmokers of both sexes (21-43 yrs) who smoked plain and mentholated cigarettes with and without filters. A rapid, initial effect of smoke inhalation was observed. EEG results for a nonsmoker smoking a cigar indicated as much change from puffing the cigar as from inhaling it. Computer methods are being developed to determine grand means and between-subject variances for the entire spectrum from 1-36 cps. Preliminary EEG data indicate effects of smoking to be stimulant rather than tranquilizing, although subjects exhibit individual differences.

MURTHY S N S, DINOSO V P, CLEARFIELD H R, CHEY W Y 271
 SIMULTANEOUS MEASUREMENT OF BASAL PANCREATIC, GASTRIC ACID
 SECRETION PLASMA, GASTRIN AND SECRETIN DURING SMOKING
 GASTROENTEROLOGY 73:(4) 758-761, 1977

The effect of smoking four unfiltered cigarettes for 1-hour on basal gastric acid and pancreatic secretion was studied in 10 subjects with a history of duodenal ulcer and 10 subjects without

any gastrointestinal disorder. Smoking resulted in a transient increase in basal acid secretion for both groups but was significant only for ulcer subjects. Fluid and bicarbonate secretion were inhibited during the smoking period, but returned to control levels within 30-60 min in the ulcer group and within 60-90 minutes in the nonulcer group. Basal pancreatic secretion inhibition correlated with plasma nicotine concentrations. Plasma levels of secretion and gastrin were not altered by smoking. Findings indicate that smoking induces changes in basal gastric and pancreatic secretions which are independent of plasma gastrin and secretin levels but which are associated with plasma nicotine levels. These secretory changes provide a mechanism whereby smoking may contribute to duodenal ulcer disease and to secondary marked and prolonged inhibition of pancreatic bicarbonate secretion, causing a highly acidic pH in the duodenal bulb for prolonged periods.

MYRSTEN A L, ANDERSSON K 361
 INTERACTION BETWEEN EFFECTS OF ALCOHOL INTAKE AND CIGARETTE
 SMOKING
 DTIC TECHNICAL REPORT NO. AD919893, 1973

Combined effects of alcohol intake (0.72 g/kg body wt whiskey) and cigarette smoking (5 cigarettes within 175 min) were determined in male subjects (n = 12, 22-27 yrs old) during a 3 hr period in which they performed visual reaction time tests. Subjective intoxication was slightly higher during the combined alcohol and cigarette condition than in the alcohol condition. The main effects of alcohol as compared to control values (water intake) were a slight increase in heart rate and skin temperature; a decrease in hand steadiness; and an increase in visual reaction times. Cigarette smoking caused an increase in heart rate which remained elevated throughout the trials and a decrease in skin temperature which was most pronounced following the first cigarette. Hand steadiness was consistently impaired during the session. Alcohol and cigarettes combined caused a progressive increase in heart rate and a marked deterioration of hand steadiness. Maximum impairment was observed 75 min following alcohol intake. Reaction-time scores were similar to or slightly shorter than control values as cigarette smoking counteracted the deleterious effects of alcohol on performance in both simple and choice reaction-time tasks. The largest epinephrine output occurred when alcohol and cigarettes were combined. Norepinephrine excretion showed no systematic variation. Results indicate a synergistic interaction may exist between cigarettes and alcohol for the heart rate and hand steadiness variables while an antagonistic one may exist for the skin temperature and reaction time variables.

MYRSTEN A L, ANDERSSON K, FRANKENHAEUSER M, ELGEROT A 324
 IMMEDIATE EFFECTS OF CIGARETTE SMOKING AS RELATED TO DIFFERENT
 SMOKING HABITS
 PERCEPTUAL AND MOTOR SKILLS 40:515-523, 1975

Eight "low-arousal" smokers and 8 "high-arousal" smokers were selected by means of a questionnaire concerning the need to smoke in different situations. Subjects were examined under smoking and non-smoking conditions in two contrasting laboratory situations, i.e., low-arousal characterized by monotony or boredom, and high-arousal, characterized by anxiety or excitement. They were asked to perform a vigilance-type sensorimotor task in the former situation and a complex sensorimotor task in the latter. Reaction time and heart rate were measured in each situation. Under non-smoking conditions there were no differences between scores of low-arousal and high-arousal smokers. In low-arousal smokers, performance was favorably affected by smoking in the low-arousal situation only. Performance of high-arousal smokers was enhanced by smoking in the high-arousal situation only. Smoking increased heart rate in both groups and in both situations. Measurements of neurophysiological and biochemical events in the brain are needed to clarify the complex interactions between desire to smoke, characteristics of the individual, and the external environment.

MYRSTEN A L, ANDERSSON K, FRANKENHAEUSER M, MARDH A 349
 IMMEDIATE EFFECTS OF CIGARETTE SMOKING AS RELATED TO DIFFERENT
 SMOKING HABITS
 DTIC TECHNICAL REPORT NO. AD 911139, 1972

Immediate effects of cigarette smoking as related to different smoking habits were determined in male subjects (n = 16, 21-29 yrs old) under smoking and nonsmoking conditions in 2 situations (low arousal and high arousal). In the low-arousal situation, 8 subjects performed a visual-vigilance test. In the high-arousal situation, 8 subjects performed a sensorimotor test. No consistent differences were found between low-arousal smokers and high-arousal smokers under nonsmoking conditions. Smoking increased epinephrine excretion and heart rate in both low-arousal and high-arousal situations. Self-estimates indicated smoking affected the 2 types of smokers differently. Different smoking habits are related to specific differences in the immediate effects produced by smoking. Although smoking increases physiological arousal in both low- and high-arousal smokers, psychological reactions to smoking differ between the 2 groups. A

possible hypothesis is that pharmacological motives are prevalent in low-arousal smokers and psychological motives in high-arousal smokers.

MYRSTEN A L, ELGEROT M A, EDGREN B 302
EFFECTS OF ABSTINENCE FROM TOBACCO SMOKING ON PHYSIOLOGICAL AND
PSYCHOLOGICAL AROUSAL LEVELS IN HABITUAL SMOKERS
PSYCHOSOMATIC MEDICINE 39(1):25-38, 1977

Subjects were given series of psychomotor and cognitive tests: mental arithmetic, numbers corrections, Bourden letter and color word tests. During abstinence, HR 150 was decreased by 9 bpm. Preferred ergometric work loads and HR perceived by subjects as normal and just right for 5 min exercise (W pref, HR pref). Abstainers set about the same W pref on all tests; whereas smokers decreased W pref, as has been reported to be the normal response for walking and running at constant exertion level. Smokers' HR pref correlated with W pref; abstainers' HR pref was ca. 10 bpm lower than predicted by W pref; this result corroborated earlier finding that HR 150 was 10 bpm lower in abstainers than smokers. Epinephrine and norepinephrine excretion decreased, skin temperature increased, and hand steadiness was improved when the subjects stopped smoking. There were only minor differences between abstaining and smoking subjects with regard to performance in the cognitive tests. Irritation, depression, lack of concentration, sleep disturbances, anxiety, tension, and restlessness were frequently reported as abstinence symptoms. The results indicate a decrease in arousal level during abstinence.

MYRSTEN A L, FRANKENHAEUSER M, POST B, JOHANSSON G 352
ENHANCED BEHAVIORAL EFFICIENCY INDUCED BY CIGARETTE SMOKING
DTIC TECHNICAL REPORT NO. AD 893394, 1971

The effects of cigarette smoking on the behavioral efficiency of male subjects (n = 6, 20-26 yrs old) were determined during their performance of 2 visual reaction time tasks within a 100 min period. In both 2 hr sessions, subjects were alternately presented simple and choice visual reaction tasks. In 1 session, they smoked 4 cigarettes; in the other session, they did not smoke. Simple reaction time increased over time in the non-smoking condition and remained the same in the smoking condition. Choice reaction time increased slightly in the nonsmoking condition and decreased in the smoking condition. The differences between smoking and nonsmoking conditions were significant for only simple reaction time. Smoking impaired hand steadiness. Heart rate and systolic blood pressure were increased by smoking;

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NADEL J A, COMROE J H 566
ACUTE EFFECTS OF INHALATION OF CIGARETTE SMOKE ON AIRWAY
CONDUCTANCE
JOURNAL APPLIED PHYSIOLOGY 16(4):713-716, 1961

There were no differences between male and female smokers and male nonsmokers, but conductance was higher for female nonsmokers. The acute effect of cigarette smoking was measured for 36 healthy subjects and 22 smokers with cardiopulmonary disease. Conductance decreased after smoking in both groups. Inhalation of an isoproterenol aerosol reversed or prevented this effect. Additional experiments indicated that the decrease in conductance was not related to inhalation of nicotine or other volatile substances; inhalation of a nicotine aerosol did not produce the effect, and variations in concentrations of nicotine in cigarettes produced no difference in effect. A cigarette with a charcoal filter produced a decrease in conductance. These results indicate that submicronic particles in cigarette smoke somehow decrease airway conductance, possibly through bronchoconstriction. It is unclear what role bronchiolar narrowing may play in causing or influencing pulmonary disease.

NYBERG G, PANFILOV V, SIVERTSSON R, WILHELMSEN L 20
EUROPEAN JOURNAL CLINICAL PHARMACOLOGY 23:303-307, 1982.

Nicotine chewing gum (Nicorette, N group) and a placebo (P group) gum were administered in a double-blind cross over method to 8 subjects. Calf blood flow, hand blood flow, BP, HR, skin temperature, and blood nicotine were measured. (1) BP (mmHg). Mean systolic BP increased 125; there was no difference between groups P and N. (2) HR (bpm). After placebo there was no significant change; after nicotine HR increased from 70 to 77. (3) Hand Blood Flow. Both placebo and nicotine increased hand blood flow. (4) Blood nicotine. Of the 4 mg nicotine in the gum, an average of 3.33 mg was absorbed (calculated from analysis of nicotine remaining in chewed gum). (5) Symptoms. Nausea, dizziness, anxiety with nicotine gum in all subjects. (6) Summary. Nicotine gum (4 mg) produced slight changes in variables studied. Only HR change was significant; mean increase was 16% compared to 4% for placebo.

O'CONNOR K

859

INDIVIDUAL DIFFERENCES IN THE EFFECT OF SMOKING ON FRONTAL
CENTRAL DISTRIBUTION OF THE CONTINGENT NEGATIVE VARIATION: SOME
OBSERVATIONS ON SMOKERS CONTROL OF ATTENTIONAL BEHAVIOR
PERSONALITY INDIVIDUAL DIFFERENCES 3(3):2171-286, 1982

The effect of cigarette smoking on individual differences in cortical activation was studied in 20-40 yr old introverted and extroverted smokers. The amplitude of the "O" and "E" wave components of the electrocortical contingent negative variation (CNV) were measured from frontal and vertex scalp locations during simple and choice reaction time tasks. In both simple and choice reaction time tasks, the CNV was measured under both a fixed constant foreperiod (time period between warning and response stimuli) and a variable foreperiod condition. Under all four conditions, subjects were tested during smoking and sham smoking. Analysis of variance revealed significant group by smoking session effects for the later "E" (preparatory) wave component but not for the early "O" orientation wave component. "O" wave negativity was more prominent in frontal than vertex regions, especially in extroverts, but tended to be more affected by the foreperiod condition than the smoking condition. In general, smoking produced an increase in central negativity in extroverts and a decrease in parietal positivity in introverts. CNV negativity/positivity topography differences may be indicative of attentional strategies differentially deployed during smoking.

OHKUBO C

105

SOME ACUTE CARDIOPULMONARY EFFECTS OF MAINSTREAM AND SIDESTREAM
CIGARETTE SMOKE IN MAN
PREVENTIVE MEDICINE 11:173-186, 1982

Fourteen subjects inhaled six preparations for 2 seconds each: mainstream and sidestream smoke from a cigarette, and acid and alkaline nicotine aerosols. All preparations produced decreased amplitude of finger pulse wave and increased amplitude of electromyogram. All measures except duration of inspiration phase were high after inhalation of sidestream smoke if cigarette or alkaline nicotine aerosol were used than after inhalation of mainstream cigarette smoke or acid nicotine aerosol. The aerosol caused stronger and longer responses than cigarette smoke perhaps due to the relatively large diameter of nicotine aerosol particles. Nonsmokers had greater responses than smokers to the aerosol (amplitude of electromyogram) and to cigarette smoke (electromyogram and finger pulse wave). The results indicate inhalation of sidestream smoke stimulates the nasopharyngeal reflex to produce more change in cardiopulmonary function than does mainstream smoke, largely because of pH differences in the nicotine in the two types of smokes.

OSSIP D J, ANDRASIK F, EPSTEIN L H 17
THE EFFECT OF NICOTINE EXTRACTION FILTERS ON PULSE RATE AND
VASOMOTOR ACTIVITY: A METHODOLOGICAL RATE
ADDICTIVE BEHAVIORS 6:149-152, 1981

The study determined the effects of nicotine on heart rate and vasoconstriction using high and low nicotine delivery. Three subjects were tested through twelve 35-minute sessions, with pacing of smoking that included a preload interval, using unfiltered cigarettes (1.7 mg nicotine, 28 mg tar) through either a high-or low-nicotine filter which provided 0.5 or 1.3 mg nicotine - respectively. Results indicated larger increases in heart rate with the low extraction filter for the 5-min period immediately following preload at the $P = 0.05$ level. Increased relative vasoconstriction was found for the low-extraction filter.

PANGBORN R M, TRABUE I M, PIKIELNA N B 251
TASTE, ODOR AND TACTILE DISCRIMINATION BEFORE AND AFTER
PERCEPTION AND PSYCHOPHYSICS 2(11):529-532, 1967

Differential sensitivity to taste, odor, and tactile stimuli was measured throughout a 5-month period in 7 smokers and 6 non-smokers (n = 7 females, 6 males; 23-48 yrs of age) before and after smoking a cigarette. Taste stimuli consisted of sucrose, sodium chloride, citric acid, caffeine, and quinine hydrochloride; odor stimuli, vanillin and 2-butanone; and tactile stimuli, carrageenan gum. Concentration of the 8 comparison stimuli, which were evaluated against the standard, were selected to yield about 75% response. Following a smoking abstinence from the previous night, smokers evaluated a set of 8 pairs of stimuli, smoked 45 mm of a cigarette, and then evaluated a second set of 8 pairs of stimuli. Although smaller just noticeable differences (JNDs) were obtained for nonsmokers in 5 out of 8 stimuli, no significant differences in sensitivity were observed between smokers and nonsmokers. Their JND values were lower on the second trial for caffeine, quinine, and 2-butanone, and significantly lower for citric acid. Based upon the small group of subjects and stimuli tested, the effects of smoking on chemical or tactile sensitivity are not apparent.

PARKER J E, BRADHAM G B 113
THERMOGRAPHIC DEMONSTRATION OF NICOTINE-INDUCED VASOCONSTRICTION
JOURNAL SOUTH CAROLIN MEDICAL ASSOCIATION 65(12):423-425, 1969

This study demonstrates the effects on skin temperature of smoking one cigarette on subjects with known peripheral vascular diseases; arteriosclerosis obliterans, Raynaud's syndrome, post-phlebitic syndrome, and collagen diseases. Twenty patients were placed in a bed with a constant room temperature. A thermogram was taken before and after the subject smoked one cigarette in usual fashion. Results showed that skin temperature decreased on an average 2 degrees C for 18 of the 20 patients studied after smoking.

PARSONS L C, HAMME S 812
THE EFFECTS OF NICOTINE WITHDRAWAL ON THE SLEEP AWAKE CYCLE
VIRGINIA JOURNAL OF SCIENCE 27(2):86, 1976

Ten healthy females, ages 21-25, were electrophysiologically monitored to determine the effects of nicotine withdrawal on the sleep awake cycle. The subjects were divided into two groups of five persons each: Group 1 abstained from smoking for 24 hours and Group 2 abstained for 48 hours. All subjects who smoked more than 20 cigarettes a day showed decreases in heart rate (HR) on

withdrawal day (W1) and withdrawal day 2 (W2). Respiratory rate (RR) in most cases also showed decreases on both W1 and W2. In subjects smoking more than 20 cigarettes a day, delta sleep tended to increase by 25% to 50% on W1 and W2 nights and returned to normal on recovery days 1 and 2.

PEEKE S C, PEEKE H V S 181
ATTENTION, MEMORY AND CIGARETTE SMOKING
PSYCHOPHARMACOLOGY (Berlin) 84(2):205-216, 1984

Four experiments tested the effects of smoking one cigarette on verbal memory and attention. 1. Subjects ($n = 18$ males) were studied under 3 conditions of smoking: pre-trial smoking, post-trial smoking, no smoking. Recall of a 50-word list was tested immediately and after intervals of 15 and 45 min. Pre-trial smoking improved recall at 10 and 45 min. Post-trial smoking had no effect. 2. Subjects learned a 20-word list following smoking of 1.38 mg nicotine cigarette. Recall 24 hr later improved for light and moderate smokers only. There was no effect on heavy smokers. 3. Light and heavy smoker subjects smoked either a 0.4 mg nicotine (low) or 1.38 mg nicotine (high) cigarette. The high-nicotine cigarette improved performance on both immediate and delayed recall tests. The low-nicotine cigarette was less effective at improving recall. No differences between light and heavy smokers were observed for recall. Correlation ($r = 0.5$) between heart rate immediately after smoking and mean number of words recalled suggests a relationship between stimulation level and performance on word recall tests.

PETERS R, MC GEE R 724
CIGARETTE SMOKING AND STATE-DEPENDENT MEMORY
PSYCHOPHARMACOLOGY 76:232-235, 1982

Two experiments involving 30 college students and a group of 56 volunteers were conducted to determine whether cigarette smoking could produce state-dependent learning (SDL). Subjects were assigned to a high-, low-, or no-nicotine group and completed a state-anxiety test both before and after smoking. The low-nicotine cigarette appeared to be an appropriate control cigarette to use in an SDL design because it did not alter the internal state of the subject. In a second experiment, subjects who had smoked various types of cigarettes were tested on word recognition memory. Results showed nicotine content of the cigarettes smoked had a clear effect on SDL. The most likely basis for the results is the arousal produced by the nicotine in the cigarette.

PHILIPS C 535
 THE EEG CHANGES ASSOCIATED WITH SMOKING
 PSYCHOPHYSIOLOGY 8(1):64-74, 1971

Computer methods were used to examine form and duration of EEG changes under both resting and working critical flicker fusion (CFF) vision task conditions, up to 20 min following smoking 1 cigarette. Male moderate smokers ($n = 6$, 25-35 yr) whose EEG's were normal and showed no structural pathology were selected for the experiment. The 6 parts of the experimental design were 3 min rest period, 6 min CFF, 5 min of smoking or conversation, 8 min CFF, 3 min rest period, and 8 min CFF. Power spectral analysis revealed reductions in the peak alpha frequency component up to 20 min following smoking, during the CFF task. Eyes open resting data showed a similar but not significant loss after 8 min. No indications of increased fast activity were found. These findings support the view that small amounts of nicotine absorbed in cigarette smoking act as a stimulant or activator.

PIMM P E, SILVERMAN F, SHEPHARD R J 540
 PHYSIOLOGICAL EFFECTS OF ACUTE PASSIVE EXPOSURE TO CIGARETTE SMOKE
 ARCHIVES ENVIRONMENTAL HEALTH 33:201-213, 1978

Effects of passive inhalation of cigarette smoke at levels typically encountered in public buildings were studied. Normal nonsmokers (10 males and 10 females, 18-20 yr) were each exposed for 2 hr on alternate days to either room air or air plus machine-produced cigarette smoke. Concentrations of 0.25 ppm carbon monoxide above ambient level and >4 mg/cu.m particulate were estimated to be present in the room. Subdivisions of lung volume, maximum expiratory flow-volume curves, single-breath nitrogen without curves, blood carboxyhemoglobin levels, and heart rates were obtained before, during, and after exposure. A submaximal bicycle ergometer test and a symptom questionnaire were administered after exposure. The magnitude of the changes was small and of questionable biological significance. Despite the relatively small physiological changes, subjective complaints were common: cough, nasal irritation, and eye irritation. It is concluded that in normal subjects the magnitude of physiological responses to acute exposures is minimal.

PIPER D W, RAINE J M 467
 EFFECT OF SMOKING ON GASTRIC SECRETION
 LANCET 1:696-698, 1959

Twelve smokers were tested to determine the effects of smoking on gastric secretion. Three of the subjects had peptic ulcers. After each subject fasted and refrained from smoking for 10

hours, basal secretion was studied for 1 hour, then the subject smoked 4 to 6 filter-tip cigarettes during the 2nd hour, and maximum secretory response to histamine was estimated during the 3rd hour. On a 2nd occasion, the same subjects were studied for 2 basal hours only. Secretion in the 2nd (smoking) hour showed an increase over the basal hour of over 100% in free acid and total acid output as well as an increase in volume and in chloride output. A study of four subjects showed that smoking stimulated both the parietal cell and non-parietal cell components of gastric secretion.

POMERLEAU O F, TURK D C, FERTIG J B 151
THE EFFECTS OF CIGARETTE SMOKING ON PAIN AND ANXIETY
ADDICTIVE BEHAVIORS 9:265-271, 1984

Healthy, male smokers ($n = 6$, mean age 28.5 years) smoked an average of 19.2 ± 4.6 cigarettes/day with a current mean smoking rate of 25.8 ± 5.7 cigarettes/day (37.1 ± 4.1 mg/day of nicotine). Thresholds for pain awareness were greater in 5/5 subjects when they smoked. The mean of threshold differences after smoking usual- and zero-nicotine cigarettes was greater than zero. Decreased perception of pain after they smoked their usual cigarette was reported by 3/5 subjects. Peripheral skin temperature of the nonimmersed hand decreased more after smoking the usual-nicotine cigarette (-4.3 ± 0.9 C) than after the zero-nicotine cigarette (-0.7 ± 0.4 C). For all subjects, subjective ratings of anxiety decreased significantly more after smoking the usual-nicotine cigarette than after the zero-nicotine cigarette. The finding of pain and anxiety reduction in minimally deprived nicotine-dependent smokers, in conjunction with the finding of antinociceptive and anxiolytic effects of nicotine administration in nondependent organisms, strengthens the hypothesis that nicotine from smoking can produce direct relief from pain and anxiety.

PUDDEY I B, VANDONGEN R, BEILIN L J 205
HAEMODYNAMIC AND NEUROENDOCRINE CONSEQUENCES OF STOPPING SMOKING
-- A CONTROLLED STUDY
CLINICAL AND EXPERIMENTAL PHARMACOLOGY AND PHYSIOLOGY 11:423-426, 1984

Sixty-six smokers were divided into two groups to study the effect of smoking on blood pressure. Laboratory assessment at baseline and at the end of the study included a cold pressor test and assays for epinephrine, norepinephrine, cortisol, and prolactin. Questionnaires were given to detect changes in physical activity, diet, and anxiety. Subjects who successfully stopped

smoking showed a delay in return of systolic blood pressure to basal values in the cold pressor test, increased weight, and decreased alcohol consumption. The experimental group showed an increased anxiety level. Both groups had lower norepinephrine levels after the study than at the beginning. Relative to control subjects, quitters exhibited a decrease in epinephrine and cortisol. These results suggest that smoking modifies the physiological response to stress and that stopping smoking might cause an increase in blood pressure in the long term.

PURSELL E D, SANDERS R E, HAUDE R H 257
 SENSITIVITY TO SUCROSE IN SMOKERS AND NONSMOKERS: A COMPARISON
 OF TSD AND PERCENT CORRECT MEASURES
 PERCEPTION AND PSYCHOPHYSICS 14(1):34-36, 1973

Taste sensitivity to sucrose was determined in smokers (n = 5 females, 5 males; 18-28 yrs of age) and nonsmokers (n = 5 females, 5 males; 18-28 yrs of age) while performing two discrimination tasks. Responses were based on a 6-point scale and each mean score was based on 140 judgments per subject. Analysis of theory of signal detection (TSD) measures showed smokers to be significantly more sensitive than nonsmokers in evaluating near threshold (NT) solutions and sensitive, though not significantly, in evaluating suprathreshold (ST) solutions. Analyses using the percent correct measure showed no significant differences between smokers and nonsmokers on either the NT or ST task. Smokers are more sensitive to sucrose than nonsmokers. This effect may be due to a reflexive enhancement phenomenon. A decreased sensitivity to the bitter taste (contained in cigarette smoke) in smokers results in increased sensitivity to the sweet taste. TSD measures of sensitivity are more accurate than percent correct responses measures.

RABINOWITZ B, LAGUARDA R, HUBER G L, ABELMANN W H 479
 SYSTOLIC TIME INTERVALS IN THE STUDY OF CARDIOVASCULAR EFFECTS OF
 CIGARETTE SMOKING
 CLINICAL RESEARCH 23(3):202A, 1975

The cardiovascular effects of cigarette smoke were studied among 13 subjects, 7 smokers and 6 nonsmokers, before and after smoking 1 synthetic nicotine and tobacco free cigarette and before and after 1 Kentucky reference cigarette with 20 mg of nicotine. Heart rate, systolic and diastolic blood pressure, corrected pre-ejection period, corrected left ventricular ejection time, and corrected pre-ejection period/corrected left ventricular ejection time were unaffected by smoking the synthetic nicotine and tobacco-free cigarette. Changes after smoking the reference cigarette were significant for heart rate and blood pressure. Data suggest that smoking of Kentucky reference cigarettes increases myocardial oxygen consumption. This noninvasive approach is applicable to the further delineation of the physiologic effects of smoking and of the components of smoke responsible for these effects.

RABINOWITZ B D, THORP K, HUBER G L, ABELMANN W H 66
 ACUTE HEMODYNAMIC EFFECTS OF CIGARETTE SMOKING IN MAN ASSESSED BY
 SYSTOLIC TIME INTERVALS AND ECHOCARDIOGRAPHY
 CIRCULATION 60(4):752-760, 1979

Sixteen healthy subjects, both smokers and nonsmokers, were studied using systolic time intervals and echocardiography before and after smoking a high-nicotine cigarette and a very low-nicotine cigarette, to assess and compare the acute hemodynamic effects upon left ventricular function. High- and low-nicotine cigarettes both caused increases in heart rate and systolic and diastolic blood pressure in smokers and nonsmokers. Each cigarette caused changes in echocardiograph parameters. It is concluded that smoking a nicotine cigarette induces the same physiologic responses as isometric exercise. There may be other inotropic or chronotropic agents in tobacco cigarette smoke that are as yet unknown.

RACK J, SONNENBERG A 164
 THE INFLUENCE OF SMOKING AND INTRAVENOUS NICOTINE ON GASTRIC
 MUCUS
 HEPATO-GASTROENTEROLOGY 30:258-260, 1983

Bound N-acetylneuraminic acid (NANA) is an essential constituent of mucus. In order to examine whether smoking changes gastric mucus secretion, the concentration of N-acetylneuraminic acid was measured in the gastric juice of 10 non-smokers and 10 smokers.

Gastric juice was aspirated during intravenous infusion of 0.67 ug/kg/hr pentagastrin given alone or together with 5 ug/kg/hr nicotine. Instead of intravenous nicotine, the 10 smokers smoked 5 cigarettes over a period of 2 hours. In the fasting gastric juice and during infusion of pentagastrin, the gastric concentration and output of bound N-acetylneuraminic acid were similar in smokers and in non-smokers. Acute nicotine administered intravenously or by smoking had no effect on gastric NANA. Neither chronic nor acute consumption of nicotine affects gastric turnover or adherence of mucus to the mucosa.

RAPAPORT S I, FRANK H A, MASSELL T B 880
THE EFFECT OF SMOKING UPON BLOOD FLOW IN SYMPATHECTOMIZED LIMB CIRCULATION 2:850-858, 1950

The persistence of the vasoconstrictor response to smoking after sympathectomy was studied by measuring the effects of smoking on the skin temperature and blood flow of 18 subjects who had recently undergone sympathectomy. Both skin temperature and heart rate remained the same before and after smoking. Blood flow was not decreased in 18 subjects. This shows that the vasoconstrictor effect of smoking requires an intact sympathetic nerve supply to the blood vessels and is not the result of humoral mechanisms. There was no difference in the response of patients sympathectomized for thromboangiitis obliterans, arteriosclerosis obliterans, or severe vasospasm.

RASP F L, CLAWAON C C 764
REVERSIBLE IMPAIRMENT OF THE ADHERENCE OF ALVEOLAR MACROPHAGES FROM CIGARETTE SMOKERS
AMERICAN REVIEW RESPIRATORY DISEASE 118:979-986, 1978

The reversibility of the adherence of alveolar macrophages from smokers was investigated in 33 smokers and nonsmokers using a standardized nylon fiber assay and scanning electron microscopy. The adherence of alveolar macrophages from cigarette smokers was uniformly decreased. However, after 2 months' abstinence the defect was not found, which was not attributable to factors in lavage fluids and was not apparent in polymorphonuclear leukocytes. The surface of alveolar macrophages from smokers showed marked alterations that could affect the ability to adhere. These results indicate that alveolar macrophages from smokers have a defect in structure and adherence that may influence their function and may account for the increased yield of alveolar macrophage from cigarette smokers.

REES P J, AYRES J G, CHOWIENCZYK PJ, CLARK T J
 IRRITANT EFFECTS OF CIGARETTE AND CIGAR SMOKE
 LANCET 2(8306):1015-1017, 1982

11

Airways resistance was measured by body plethysmography in 6 male smokers and 6 male nonsmokers following a single puff and inhalation from 5 types of cigarettes and 1 type of cigar. Resistance measurements expressed as specific conductance; puff volume and inhalation volume were also measured. Smallest volumes were taken from unfiltered and largest volumes from mildest filtered cigarettes (lowest nicotine, tar, and carbon monoxide). Greatest decreases in airway were in nonsmokers from unfiltered high-tar cigarettes and in smokers, from cigars. Responses to the mildest cigarettes were indistinguishable; no significant difference between the responses to the cigar and the high-tar cigarette was found. Airway narrowing from a single cigarette was transient, decreasing over 30 sec.

REINTJES M, BOGAARD J M, SWIERENGA J 580
 EFFECT OF SMOKING ONE CIGARETTE ON AIRWAY RESISTANCE
 SCANDINAVIAN JOURNAL RESPIRATORY DISEASE 53:129-134, 1972

Airway resistance of 30 untrained subjects, 15 smokers and 15 nonsmokers, was measured before smoking a cigarette, immediately afterward, and 15, 30, and 60 min afterward. A volume-constant body plethysmograph was used to make these measurements. At the same time, forced expiratory volume in 1 sec as a percentage of vital capacity was measured. Analysis of variance showed no significant difference in airway resistance between smokers and nonsmokers; although at all times smokers had higher resistance. The 2 groups showed the same pattern of resistance over time. Mean resistances at different times were different; resistance was greatest immediately after smoking but the means at the 4 other times showed relatively small differences. The spirographic measures showed no significant divergence between groups or times. These results are compared with results of other similar studies.

RENAUD S, BLACHE D, DUNMONT E, THEVENON C, 157
 WISSENDANGER T
 PLATELET FUNCTION AFTER CIGARETTE SMOKING IN RELATION TO NICOTINE
 AND CARBON MONOXIDE
 CLINICAL PHARMACOLOGY THERAPEUTICS 36(3):389-395, 1984

A total of 26 smokers participated in experiments concerning the effects of cigarette smoking on platelet function. In the first set of experiments (using three different cigarettes, 0.07, 0.58, and 1.44 mg nicotine) only the cigarettes with the two higher nicotine levels caused increases in clotting and platelet

aggregation. None of the cigarettes affected carboxyhemoglobin levels. The second set of experiments used cigarettes delivering 0.18, 0.40, 0.58, and 1.44 mg nicotine. Clotting and aggregation only to certain aggregators was increased by the high-nicotine cigarettes compared with the 0.18 mg cigarette only. Platelet activity correlated with blood nicotine levels but not with carboxyhemoglobin levels. Nicotine added in vitro, to platelet-rich plasma from six subjects, induced a rise in platelet reactivity like that seen after smoking. Rutin, a component of tar, also increased aggregation in platelet-rich plasma. These experiments suggest that smoking cigarettes does enhance platelet function as measured by certain tests. This effect is partly explained by delivered nicotine and blood nicotine levels. Nicotine and substances in tar may also contribute to this effect.

ROBERTSON D G, WARRELL D A, NEWTON-HOWES J S,
FLETCHER C M
BRONCHIAL REACTIVITY TO CIGARETTE AND CIGAR SMOKE
BRITISH MEDICAL JOURNAL 3:269-271, 1969

567

A body plethysmograph was used to measure specific airway conductance of 91 smokers before and after smoking a cigarette. Subsequently, 19 of the most reactive subjects smoked three different cigarettes: one with a filter having 50% retention efficiency, and one containing cigar tobacco and having a filter with 36% retention efficiency. The change in airways conductance after smoking was less for the cigarette with the most efficient filter. The changes after smoking the other two cigarettes were not different from each other. A study of 3 of the subjects showed that the response to the cigarettes was greater after 10 puffs than after 5 or 15 puffs, except for the cigarette containing cigar tobacco, which showed maximal response after 15 puffs. A study of 4 of the subjects showed airway conductance returns rapidly to baseline after smoking stops. The results indicate that reactivity to cigarette smoke is decreased by increasing the filter's retention efficiency. Reactivity to cigar-tobacco smoke, if inhaled, is no less than reactivity to cigarette smoke.

RODE A, SHEPHARD R J
SMOKING WITHDRAWAL AND CHANGES OF CARDIORESPIRATORY FITNESS
AMERICAN REVIEW OF RESPIRATORY DISEASE 104(6):933-935, 1971

207

Smokers were asked to visit a fitness laboratory during an initial smoking withdrawal program and again a year later. Immediate changes that accompanied the program were lower resting and exercise heart rates and elimination of carbon monoxide from

the blood. Over the 1-year period, almost all patients gained weight. Patients who gave up smoking gained the most weight. Skinfold thicknesses showed matching gains. Initial aerobic power was low; patients who quit smoking showed an insignificant increase in absolute aerobic power and a decrease in relative aerobic power. Among patients who contributed to smoke, women showed decreased absolute and relative aerobic power, and men showed no change in absolute aerobic power and decreased relative aerobic power in patients who gained weight. Initially, several patients showed horizontal depression in the ST segment of the electrocardiogram; a year of abstinence from cigarettes did not change the incidence of abnormal findings. Both weight gain and reversal of carbon monoxide-induced polycythemia prevented improvement in aerobic power. Smoking withdrawal clinics should advise patients about diet and the need for increased physical activity.

ROSE J E, JARRIK M E, ROSE K D 161
 TRANSDERMAL ADMINISTRATION OF NICOTINE
 DRUG AND ALCOHOL DEPENDENCE 13:209-213, 1984

Physiological response to nicotine topically applied to the skin was measured in a normal healthy adult male volunteer. Nicotine base (9 mg) was applied in a 30% aqueous solution to intact skin on the underside of the forearm. Salivary nicotine, heart rate, and blood pressure were monitored for 12 hours after application of the nicotine. Within 30 minutes, a significant level of nicotine was detected in saliva (50 ng/ml), heart rate increased by 15 beats/min (from 65 to 80), systolic blood pressure increased 10 mm Hg (from 125 to 135), and diastolic blood pressure increased by 15 mm Hg (from 95 to 110). Nicotine levels remained high for 2 hours and were comparable to levels of nicotine produced by cigarette smoking. Since transdermal nicotine would eliminate the side effects of nicotine chewing gum, it would likely increase compliance with smoking cessation treatment over that with gum.

ROSENBERG J, BENOWITZ N L, JACOB P, WILSON K M 19
 DISPOSITION KINETICS AND EFFECTS OF INTRAVENOUS NICOTINE
 CLINICAL PHARMACOL 23(4):517-522, 1980

Nicotine was given intravenously to six smokers during acid and alkaline urine conditions. Nicotine induced a sensation of arousal, increases in heart rate and blood pressure, and decrease in skin temperature, but subjects developed tolerance to all but the last effect as the series of injections continued. Although the amount of nicotine excreted depended on urinary pH, urinary pH did not affect distribution volume. Neither did it affect

subjective or cardiovascular responses to nicotine. This study suggests that the effect of smoking does not vary with urinary pH.

ROTH G M, MC DONALD J B, SHEARD C

495

THE EFFECT OF SMOKING CIGARETTES

JOURNAL OF AMERICAN MEDICAL ASSOCIATION 125(11):761-767, 1944

Circulatory, cutaneous, and metabolic changes during cigarette smoking or intravenous nicotine were studied in six healthy smokers (4 male and 2 female). Cutaneous temperatures of the extremities of all subjects while resting decreased after smoking two standard cigarettes or tobacco cigarettes with ashless cigarette paper or standard cigarettes with a filter holder. An increase in the basal metabolic rate occurred after the smoking of two standard cigarettes. Changes in the electrocardiographic tracing consisted of an increase of heart rate and a lowering of the amplitude of the T wave. When saline solution was given prior to the intravenous injection of nicotine, there was a slight decrease in cutaneous temperatures of the extremities, but when nicotine was added to the solution, the decrease was rapid and pronounced. After the injection of nicotine, the electrocardiographic tracing demonstrated a definite increase in heart rate and a decrease of the T waves greater than that seen after the subjects had smoked two standard cigarettes. There was an increase of blood pressure and heart rate smoking two standard cigarettes or the intravenous injection of nicotine. Some subjects showed parallelism between hyperreaction to the cold pressor test and hypersensitiveness to tobacco. Two hyperreacted to one or the other alone. After the subjects had smoked standard cigarettes, blood pressure, heart rate, and the electrocardiogram returned to normal within 5-15 min. Peripheral vascular constriction indicated by cutaneous temperatures of the extremities persisted 30-60 min, and in some cases, longer. It is concluded that the smoking of standard cigarettes should be avoided in the presence of peripheral vascular disease or arterial trauma.

ROTH G M, SHEARD C

876

THE EFFECT OF SMOKING ON THE VASODILATATION PRODUCED BY THE ORAL ADMINISTRATION OF 95 PERCENT ETHYL ALCOHOL OR A SUBSTANTIAL MEAL
AMERICAN HEART JOURNAL 44:654-662, 1947

To determine if the oral administration of alcohol or the ingestion of a substantial meal would prevent the vasoconstriction response to smoking, the skin temperature, blood pressure, and heart rate of 65 normal habitual smokers were measured. When smoking after ingestion of alcohol, skin temperature

decreased below the basal level in 72% of the subjects. The differences in blood pressure and heart rate when smoking before and after food or alcohol were not significant. These results indicate that the vasoconstriction response of smoking cannot be prevented by alcohol or food at any time during vasodilation.

ROTTENSTEIN H, RUSS E, FELDER D J, MONTGOMERY H
EFFECT OF NICOTINE ON MUSCLE BLOOD FLOW IN MAN
CIRCULATION 20:760, 1969

496

The effect of nicotine on blood flow in human skeletal muscle was measured using venous occlusion plethysmograph combined with skin-blanching by epinephrine iontophoresis. The Hinset thermoelectric needle was used in some instances. When both methods were used, the needle was placed in one calf and the plethysmograph on the other. Distal to the plethysmograph, the circulation of the foot was largely excluded by cuff pressure. Changes in cutaneous flow in toes were estimated by skin temperatures in a 20 degree C room. Nicotine was administered intravenously in a single dose of 1 to 2 mg in 1 min or of 3 mg in 4 min. The cutaneous flow decreased, and by both methods of measurement the muscle blood flow increased. The period of this increase was shorter than the decrease in cutaneous flow.

ROWE J W, KILGORE A, ROBERTSON G L
EVIDENCE IN MAN THAT CIGARETTE SMOKING INDUCES VASOPRESSIN
RELEASE VIA AN AIRWAY-SPECIFIC MECHANISM
JOURNAL CLINICAL ENDOCRINOLOGY METABOLISM 51:170-172, 1980

26

This study compares plasma vasopressin response of i.v. nicotine (2 mg) and inhalation of smoke from high (1.2 mg) and low (0.6 mg) nicotine cigarette content. I.v. administration of nicotine resulted in no effect on plasma vasopressin, a transient increase in mean BP and HR (peaking at 10 min), and symptoms of light-headedness. Low and high nicotine cigarettes resulted in an increase in plasma vasopressin (high nicotine cigarettes had a greater increase), symptoms of light-headedness after high nicotine cigarette and nausea after low-nicotine cigarettes. All 3 interventions yielded transient increase in BP and HR of similar magnitude. Smoking both cigarettes is followed by a transient increase in BP of significant magnitude to those seen after i.v. nicotine administration. The increase above basal plasma vasopressin is greater after high-nicotine cigarettes than low-nicotine cigarettes. Nicotine-induced vasopressin release is mediated by cervical parasympathetic mechanisms. The anti-diuresis that follows bolus i.v. nicotine injection is not seen after interrupting cervical parasympathetic pathways or after carotid nicotine injection. Smoking in the absence of nausea,

vomiting, or decreases in BP induces vasopressin release. Studies suggest that this effect is mediated by an airway-specific mechanism. The magnitude of the plasma vasopressin response is related to the tar and nicotine content of the cigarette smoked. It is not the act of smoking itself but rather some component of the vapor phase of the smoke which is responsible for vasopressin release. If present, an airway-specific mechanism for vasopressin release related to the common clinical observation that a variety of pulmonary diseases are associated with inappropriate antidiuresis.

RUMMEL R M, CRAWFORD M, BRUCE P 541
THE PHYSIOLOGICAL EFFECTS OF INHALING EXHALED CIGARETTE SMOKE IN
RELATION TO THE ATTITUDE OF THE NONSMOKER
JOURNAL SCHOOL HEALTH 45:524-529, 1975

Fifty-six college students were studied for two major purposes: to determine the effects on heart rate and blood pressure when a nonsmoker inhales the exhaled smoke from a cigarette smoker, and to investigate the effects of such inhalation in relation to the attitudes of the nonsmoker toward breathing exhaled smoke. In a closed environment after 5, 10, 15 and 20 minutes of exposure to exhaled smoke, the nonsmokers' heart rates and blood pressures were monitored. Subjects were also grouped according to whether they disliked, or were indifferent to, the presence of cigarette smoke. Results indicated that the "dislike" group had higher heart rates than the "indifferent" group on all trials. Systolic pressure was not significantly different between groups. It could not be determined if the higher heart rates in the "dislike" group were true or were caused by the anticipation of the situation. Further research into this area is suggested.

RUSKIN J, GEBEL P P, HART L, THOMPSON H K, MC INTOSH H D 88
RETINAL VASCULAR RESPONSES TO NITRATES AND CIGARETTE SMOKING
SOUTHERN MEDICAL JOURNAL 62:324-328, 1969

This report described use of both fluorescence retinal cinematography and conventional still photography in evaluating the effects of vasoactive substances upon retinal vasculature. Retinal arteriovenous transit time (AVTT) did not change after smoking 2 cigarettes. There was a small decrease in mean vessel diameter.

SACHS D P L, BENOWITZ N, HALL S M 837
 CARDIOVASCULAR EFFECTS OF NICOTINE AND CARBOXYHEMOGLOBIN DURING
 SMOKING
 CLINICAL RESEARCH 29(2):277A, 1981

The cardiovascular effects of normal rate smoking and rapid rate smoking over a 16-minute period were compared in 14 regular cigarette smokers with coronary heart disease but no hypertension. Serum nicotine levels increased from baseline in both normal and rapid smoking conditions. Arterial carboxyhemoglobin increased between baseline and normal smoking and between baseline and rapid smoking but was not significantly different between normal and rapid smoking. Heart rate increased over baseline for both smoking conditions. Systolic blood pressure was increased only during the rapid smoking condition; diastolic blood pressure increased during baseline and both smoking conditions. Arterial pH, PaO₂, and PaCO₂ were unchanged across all three conditions. Regression analysis revealed an inverse relationship between heart rate and serum nicotine levels. It is concluded that there is not a simple positive correlation between nicotine consumption and cardiovascular change. Vagal nerve tone may mediate the nicotine effects. Finally, even for coronary heart disease patients, exposure to relatively large amounts of nicotine may produce no more cardiovascular stress than small amounts.

SACHS D P L, BENOWITZ N, HALL S M 865
 PARADOXICAL CARDIOVASCULAR EFFECTS OF NICOTINE DURING RAPID
 SMOKING THERAPY
 AMERICAN REVIEW RESPIRATORY DISEASES 123:151, 1981

To clarify the physiologic effects of nicotine during rapid smoking therapy, 21 smokers with symptomatic obstructive pulmonary disease or coronary heart disease were studied. Serum nicotine increased for normal smoking and rapid smoking. Heart rate increased for normal and rapid smoking, but was not significantly different between the two groups. Systolic blood pressure was higher for rapid smoking and diastolic blood pressure increased in all conditions. Arterial carboxyhemoglobin increased for normal and rapid smoking, but was not significant between normal and rapid smoking. Arterial pH, PaO₂, and PaCO₂ did not change across conditions. The inverse relationship between serum nicotine and heart rate indicates that there is not a simple, positive relationship between serum nicotine or nicotine consumption and cardiovascular change. Thus, for the patients in these two disease groups, consuming large amounts of nicotine for a smoking cessation program may not produce any more cardiovascular stress than small amounts.

SAKURAI M 810
 INFLUENCE OF THE SKIN TEMPERATURE ON THE AXON REFLEX PILOMOTION
 PRODUCED BY NICOTINE IN HUMAN SKIN
 TOHOKU JOURNAL EXPERIMENTAL MEDICINE 128(1):1-12, 1979

Intradermal injections of 0.1 ml of nicotine solution were given to five young men to determine the effect of skin temperature on the axon reflex pilomotion (goose flesh) produced by the injections. The forearm was immersed in a water bath in which the temperature of the effector region was controlled independently of the temperature at the receptor site. The responsiveness of the axon reflex receptor by nicotine was found to be constant in a range from 20 to 40 C. Thus, the reaction of the receptor to temperature was pharmacologically similar to that of autonomic ganglion.

SANNITA W G, CROTTI N, MASSA T, MORASSO G, ROSADINI G,
 TIMITILLI C 820
 ELECTROPHYSIOLOGICAL CONCOMITANTS OF THE LONG-TERM WITHDRAWAL
 FROM CIGARETTE SMOKING: A PILOT STUDY
 RESEARCH COMMUNICATIONS IN PSYCHOLOGY PSYCHIATRY BEHAVIOR
 9(3):273-284, 1984

Electrophysiological changes and nicotine plasma concentrations were studied in 23 habitual smokers, who were requested to decrease their smoking gradually over a 3-month period. Definite EEG abnormalities were detectable upon visual inspection of the tracings in seven subjects at the beginning of the study; these occurred when nicotine plasma levels were above 70 ng/ml. Systematic changes were not observed with quantitative EEG analysis, with the exception of variations in the right-to-left ratios of the signal amplitude. A trend towards increase was observed in the latency of the late components of the visual evoked potentials, while the contingent negative variation was not modified. These findings suggest electrophysiological concomitants of a "tardive withdrawal syndrome." the appearance of EEG abnormalities during tobacco deprivation has practical relevance in clinical EEG recordings.

SCHALLING D, WALLER D 355
 PSYCHOLOGICAL EFFECTS OF TOBACCO SMOKING
 ACTA PHYSIOLOGICA SCANDINAVIA 479:53-56, 1980

The effects of tobacco smoking on psychophysiological and pain measures were studied and interpreted in terms of arousal regulation or reward effects. Subjects were 28 male moderate smokers who participated in a smoking (S) and a non-smoking (NS) condition. There was a marked improvement in CFF performance with a

maximum 8 min after the first puff. Performance was higher in the S condition compared to the NS condition from 5 min after the first puff to 20 min after the last puff. In the presmoking period, the performance was almost identical in the S and NS conditions. In the smoking period, performance was improved in the S condition, followed by a slight decrease in the post-smoking period. In the NS condition, there was a slight impairment in performance over the presmoking, smoking, and post-smoking periods. The smoking-induced improvement in ability to discriminate visual stimuli is interpreted as an indicator of an increased level of cortical arousal. When the most and least improved groups in the S condition were compared, the improved group had higher scores in an extroversion scale. In another study, skin conductance was recorded during seven successive rest periods surrounding short pain toleration measurements. In the group of subjects who were allowed to smoke, spontaneous fluctuations showed an increase which was of very short duration and most pronounced during the first minute of smoking. The results suggest an acute acetylcholine-mediated phasic increase in reticular-cortical arousal. In the third study, pain thresholds and tolerance levels were obtained with a method of limits (ML). The effects of smoking on the ability to discriminate between electrical stimuli of different intensity and the effects on response criteria related to non-sensory, motivational factors were also studied. There were sex differences in the smoking-induced change in ability to discriminate strong stimuli, male being somewhat improved and females impaired. Smoking increased pain tolerance levels in male subjects and, independently of sex, in subjects low in psychic anxiety. These results may be related to nicotine effects on cholinergic reticular transmission systems, and the release of endorphins which may be facilitated by smoking. It is concluded that the mediation of the reward-related effects of smoking may be pharmacologically different from the mediation of the effects on reticular-cortical arousal suggested by the CFF and skin conductance findings. Further study on individual differences in smoking effects and their psychophysiological and biochemical correlates is recommended.

SCHECHTER M D, RAND M J 524
 EFFECT OF ACUTE DEPRIVATION OF SMOKING ON AGGRESSION AND
 HOSTILITY
 PSYCHOPHARMACOLOGIA 35:19-28, 1974

Reaction time of subjects was tested during two sessions using the Buss aggression machine. For nonsmokers, the two sessions were conducted the same. In contrast, smokers were allowed to smoke during breaks at one session but not at the other. At the end of the second session, all subjects were asked to complete the Buss-Durkee hostility inventory. Nonsmokers showed no difference in aggression or reaction time between sessions; smokers

showed no difference in reaction time between sessions but had higher aggression scores in nonsmoking sessions than in smoking sessions. Aggression scores correlated with scores on the hostility inventory, indicating that the aggression machine provides a valid measure of aggression. This study suggests that increase in aggression under conditions of smoking deprivation may be a factor in continuing the smoking habit.

SCHNEDORF J C, IVY A C 272
THE EFFECT OF TOBACCO SMOKING ON THE ALIMENTARY CANAL
JOURNAL OF AMERICAN MEDICAL ASSOCIATION 112:898-903, 1938

The effects of cigarette smoking or s.c. injection of nicotine on gastro-intestinal activities were studied in smoking and non-smoking normal human subjects, patients with peptic ulcer, and dogs. Results indicated that smoking, but not subcutaneously injected nicotine (0.4 mg), stimulates salivation in most smoking and nonsmoking subjects. Hunger contractions of the stomach in human subjects tended to decrease for 15-60 min following smoking one cigarette. While subcutaneous nicotine injection (1 mg) did not inhibit such contractions in dogs, inhalation of cigarette smoke inhibited the gastric motility promptly. Such inhibition was blocked by sectioning of the vagi above the diaphragm, indicating reflex control of these contractions via vagal motor pathways. In normal smokers, gastric acidity was decreased. Neither emptying time nor acidity were affected by smoking in the ulcer group. Subcutaneous injection of 1 mg nicotine decreased by acid secretion in one of three dogs following meal ingestion. In both smokers and nonsmokers, smoking increased colon motility. Following increases in gastric retention (emptying rate), gastric acidity, adverse cardiovascular effects (fainting after smoking on an empty stomach), and increase in colon motility, it is concluded that as a person approaches his limit of tolerance to tobacco, undesirable changes occur in alimentary tract physiology. Patients with peptic ulcer or colon disorders should not strain their tolerance to tobacco.

SCHNEIDER N G 857
THE EFFECTS OF NICOTINE ON LEARNING AND SHORT-TERM MEMORY
DISSERTATION ABSTRACTS INTERNATIONAL 39(10-B):5109B-5111B, 1978

The effects of nicotine on learning and memory were studied in human subjects to determine: the influence of high and low nicotine given pre-trial on learning and organization in a free-recall task; the permanency of any observed deficits as measured by a delayed-recall task; and the influence of high and low nicotine given post-trial on memory and consolidation. It was

predicted, based on previous research, that pre-trial nicotine administration would produce a learning deficit while post-trial nicotine administration would enhance delayed recall, and these results were expected to correlate with changes in arousal. Pre-trial nicotine-induced arousal was expected to interfere with learning while post-trial nicotine-induced arousal was expected to enhance memory consolidation. There were no significant effects of nicotine on learning, organization, or retention. It is concluded that this failure to replicate findings of a learning deficit with pre-trial nicotine may have been due to an initial "floor" effect in arousal for all groups which may have precluded the establishment of an arousal level sufficient to disrupt learning. Negative findings for the retention task may have been attributable to this factor as well as to difficulties in obtaining effects using post-trial procedures in humans. However, with greater amounts of nicotine intake there was a significant performance impairment on the jigsaw puzzle retention interval filler task. If jigsaw puzzle performance reflects concentration and nonverbal short-term memory, then it may be that these processes are sensitive to nicotine intake.

SCHNEIDER N G, JARVIK M E 143
 NICOTINE VS PLACEBO GUM IN THE ALLEVIATION OF WITHDRAWAL DURING
 SMOKING CESSATION
 ADDICTIVE BEHAVIORS 9:149-156, 1984

In a double-blind, placebo-controlled trial of nicotine gum, withdrawal symptoms were rated for 1 week in 50 subjects. Baseline responses were obtained for comparison with 5 days of smoking abstinence. Subjects (n = 26) received nicotine (2 mg) gum and 24 subjects received placebo gum. A withdrawal scale, the Smoker Complaint Scale (SCS), with 14 items, was derived from smokers' complaints in previous abstinence attempts. Heart rate changes were recorded. Carbon monoxide served to verify abstinence. Heart rate decreased significantly during abstinence for placebo vs. nicotine group. All subjects experienced increases in withdrawal over time. Placebo group reported more severe withdrawal than nicotine subjects. No sex differences in reported withdrawal were found. It is concluded that appearance of withdrawal symptoms is attributed to removal of nicotine per se. Nicotine-specific symptoms may be alleviated with nicotine gum.

SCHORI T R, JONES B W 559
 SMOKING AND MULTIPLE-TASK PERFORMANCE
 VIRGINIA JOURNAL OF SCIENCE 25:147-151, 1974

Subjects were required to perform a complex task consisting of three visual monitoring subtasks (meter, white-light, and red-light), an auditory monitoring subtask, and a mental arithmetic subtask, all of which were performed simultaneously. Subjects completed a Nowlis Mood Scale questionnaire (which measured transient mood states) before and after the testing session, consisting of six half-hour trials. To determine the manner in which smoking condition affected response latency, a two-way analysis of variance, in which complexity and smoking condition were treated as factors, was performed for each subtask. Only on the auditory subtask was a significant effect of smoking detected, this was the complexity and smoking condition interaction. Smoking, therefore, had no practical effect upon performance. Whereas at the low level of task complexity, smokers had fewer mood changes than did nonsmokers and smokers-deprived, they had more changes at the high level of task complexity. The relationship between smoking and mood change may depend on the nature of the situation in question.

SCOUGHTON C R, HEIMSTRA N W 364
 THE EFFECTS OF SMOKING ON PERIPHERAL MOVEMENT DETECTION
 DTIC TECHNICAL REPORT NO. AD/A047743, 1975

Effects of smoking on peripheral movement detection were determined in male subjects ($n = 25$, 18-30 yrs old) who were tested under 4 conditions (smoking-high illumination, smoking-low illumination, smoking deprived-high illumination, smoking deprived-low illumination). No significant differences were observed between smoking and nonsmoking subjects for either the low- or high-illumination conditions. Smoking-deprived subjects in the movement detection task were better than smoking subjects at detecting and responding to movement in the periphery; particularly, at the highest velocity (24 min/sec). Smoking-deprived and smoking subjects as compared to nonsmokers showed no significant differences in the movement detection task. Smoking-deprived subjects in the velocity estimation task performed better than subjects in the smoking condition. For this task, there were no smoker-nonsmoker differences observed. Smoking affects the subject's ability to visually detect peripheral movement. There is a decrease in the ability of habitual smokers under both smoking and smoking-deprived conditions to detect motion in the periphery and estimate the time of interception of a moving and stationary target.

SELTZER C C 490
 EFFECT OF SMOKING ON BLOOD PRESSURE
 AMERICAN HEART JOURNAL 87(5):558-564, 1974

This study analyzed cross-sectional and longitudinal data to compare blood pressure of 794 subjects representing four categories of cigarette smoking habits. At admission into the study, current smokers had lower systolic and diastolic blood pressure than nonsmokers and former smokers. At the five-year follow-up, 104 subjects had quit smoking. They had an increase in both systolic and diastolic blood pressure. Continuing smokers had unchanged systolic pressure and a modest decline in diastolic blood pressure. Both groups had increases in body weight, but quitters gained more than twice as much as continuing smokers. Analysis of blood pressure changes by weight change groups showed that quitters had increased systolic blood pressure whether they gained or lost weight, but diastolic pressure increased only when they gained weight. In contrast, continuing smokers had increased systolic blood pressure when they gained weight and decreased systolic blood pressure when they lost weight. When they gained weight they had little if any increase in diastolic pressure. When they lost weight diastolic pressure decreased. Quitters were far more likely than continuing smokers to have reached critical levels of hypertension. These data suggest that cigarette smoking tends to inhibit increases in blood pressure and that stopping smoking is related to increases in blood pressure, even if the quitter loses weight.

SEPKOVIC D W, HALEY N J, AXELRAD C M, WYNDER E L 152
 CIGARETTE SMOKING AS A RISK FOR CARDIOVASCULAR DISEASE III:
 BIOCHEMICAL EFFECTS WITH HIGHER NICOTINE YIELD CIGARETTES
 ADDICTIVE BEHAVIORS 8:59-66, 1983

Subjects who smoked a medium range nicotine yield cigarette were given a higher nicotine yield cigarette (an increase of 0.34 mg nicotine) to smoke ad libitum for 2 weeks. Plasma nicotine, cotinine, thiocyanate, and blood carboxyhemoglobin levels were determined as well as various physiological parameters including heart rate and blood pressure. Increases in plasma nicotine were most directly correlated to heart rate when smokers were first challenged with a higher nicotine yield cigarette ($r = 0.85$); less directly correlated after a 2-week acclimatization period ($r = 0.42$); and poorly related to their customary product ($r = 0.23$). Subjects did not compensate for higher nicotine yield by smoking fewer cigarettes per day when incremental nicotine changes were realistic. Subjects did show higher plasma cotinine with the stronger cigarettes. These increases in cigarette constituents present in plasma, coupled with increasing correlation of heart rate and nicotine uptake, suggested that up-titration of smokers might cause them to establish new baseline levels.

SEPPANEN A 737
 PHYSICAL WORK CAPACITY IN RELATION TO CARBON MONOXIDE INHALATION
 AND TOBACCO SMOKING
 ANNALS OF CLINICAL RESEARCH 9:269-274, 1977

The effect of pure carbon monoxide, carboxyhemoglobin saturation, and cigarette smoking on physical working capacity was compared for 14 smokers who performed exercise tests. Measurements were made after air breathing, after breathing a 1100 ppm carbon monoxide air mixture, and after cigarette smoking. Carbon monoxide did not change the heart rate at rest, but smoking caused an increase. Neither carbon monoxide nor smoking affected blood pressure at rest or during exercise. Physical work capacities at heart rates of 130, 150 and 170 bpm decreased after carbon monoxide inhalation and smoking, although the change was greater after smoking. The greatest decrease in calculated mean maximal work was after carbon monoxide inhalation. This deviates from physical work capacity at 170 bpm and could indicate that smoking also acts as a stimulant during exhaustive work. These results show that low carboxyhemoglobin saturation affects physical performance.

SEYLER L E, FERTIG J, POMERLEAU O, HUNT D, PARKER K 693
 THE EFFECTS OF SMOKING ON ACTH AND CORTISOL SECRETION
 LIFE SCIENCES 34:57-65, 1984

The relationships among changes in plasma nicotine, adrenocorticotrophic hormone (ACTH) and cortisol secretion after smoking were investigated. Ten male subjects smoked cigarettes containing 2.87 mg nicotine and 0.48 mg nicotine. No increases in cortisol or ACTH were detected after smoking the lower nicotine cigarettes. Cortisol increases were significant in 11 of 15 instances of smoking the higher nicotine cigarettes, but ACTH increased in only 5 of these 11 cases. Each ACTH increase was accompanied by nausea, and subjects appeared pale, sweaty, and tachycardiac. Cortisol increases were greater in nauseated than in non-nauseated smokers. The results suggest that such nausea stimulates cortisol release by stimulating ACTH secretion. Cortisol release in non-nauseated smokers appears to occur through a non-ACTH mechanism, whether nicotine or some other stimulus inherent in smoking.

SHEARD C 341
 THE EFFECTS OF SMOKING ON THE DARK ADAPTATION OF RODS AND CONES
 FEDERATION PROCEEDINGS 5:94, 1946

The effects of smoking cigarettes on the levels of dark adaptation were studied in several subjects under controlled conditions and specified criteria. These investigations show

that 1) there is a definite decrease of level of light sensitivity (0.25 to 0.75 log unit) in both rods and cones which persists for 15 to 30 minutes after inhaling smoke from two standard cigarettes; 2) the effects are practically the same if the smoke is drawn into the mouth and not inhaled; 3) there is no effect on the adaptation levels when the nicotine is removed (that is, less than 5 percent remains) from the smoke by suitable filters; 4) the responses of cones are less affected and the recovery is more rapid than for the rods; 5) the breathing of pure oxygen instead of air has little if any effect on the rate or total time of recovery to previously established levels; and 6) there is no effect of smoking cubeba, cornsilk cigarettes and similar types of material containing no nicotine. These findings show that the smoking of standard cigarettes decreases the dark adaptation levels of both rods and cones, owing largely if not wholly to nicotine.

SHEPARD R J, COLLINS R, SILVERMAN F 542
 RESPONSES OF EXERCISING SUBJECTS TO ACUTE PASSIVE CIGARETTE SMOKE
 EXPOSURE
 ENVIRONMENTAL RESEARCH 19:279-291, 1979

Responses to 2 hr of passive cigarette smoke exposure were tested in healthy nonsmokers (n = 23 men and women) who were performing intermittent bicycle ergometer work sufficient to increase respiratory minute volumes by a factor of 2.5. The main subjective symptoms were odor and eye irritation; cough, nasal discharge, stiffness, and throat irritation were also reported. A small increase of tidal volume and respiratory minute volume seemed due to anxiety rather than to airway irritation. Static lung volumes were unchanged, but 3%-4% decreases were reported for forced vital capacity, 1 sec forced expiratory volume, and maximum flow at 25% and 50% vital capacity. Changes of dynamic lung volumes were of the order anticipated from the cigarette equivalent encountered by the passive smoker. These tests provide little evidence of respiratory responses to passive cigarette smoke exposure, despite the combination of high smoke concentrations and intermittent exercise.

SHEPHERD J T 237
 EFFECT OF CIGARETTE SMOKING ON BLOOD FLOW THROUGH THE HAND
 BRITISH MEDICAL JOURNAL 3:1007-1010, 1951

Effects of the rate of smoking on blood flow through the hands of males was recorded by venous occlusion plethysmography at 32 C. Respiration, heart rate, blood pressure, and hand blood flow were monitored during smoking of a standard British cigarette: 10 min control; 10 min sham (inhaling unlit cigarette); 10 min control;

10 min smoking; 10 min control. Results show transient decrease in hand blood flow during both cigarette and sham smoking at 20 sec; blood flow otherwise unchanged through smoking intervals wherein subjects inhaled at rate of 1 puff/min. At the rate of 3 puffs/20 min, gradual decrease in hand blood flow during the smoking interval did not occur during sham smoking (n = 6). Cigarette smoking without inhalation shows no effects on hand blood flow. It is concluded that transient decreases in hand blood flow with smoking are physiological reflex effects not due to nicotine; however, hand blood flow decreases due to nicotine are observed when smoke is inhaled at a rate of 3 puffs/min.

SHIFFMAN S 214
RELAPSE FOLLOWING SMOKING CESSATION: A SITUATION ANALYSIS
JOURNAL OF CONSULTING AND CLINICAL PSYCHOLOGY 50(1):71-86, 1982

This study involved analysis of precipitants and outcomes of relapse crises among 183 ex-smokers who called a hotline for help in avoiding a return to smoking. Most crises were associated with negative effects, but other frequently cited precipitants were smoking stimuli, eating or drinking, and a feeling of relaxation. Factors associated with relapse were absence of withdrawal symptoms, presence of another smoker, drinking alcohol, and experiencing a crisis somewhere other than home or work. The data suggest that coping responses were more successful in avoiding smoking than smokers who did not use a coping response. A combination of cognitive and behavioral responses was most successful. Alcohol diminished the frequency and effectiveness of behavioral coping and depression reduced the effectiveness of behavioral coping. Cognitive coping responses appear to be relatively stable in their effectiveness and may be particularly important in coping.

SHIFFMAN S M, JARVIK M E 998
WITHDRAWAL SYMPTOMS: FIRST WEEK IS HARDEST
WORLD SMOKING AND HEALTH 5(1):16-21, 1980

In a study of smoking cessation withdrawal symptoms, 40 participants in a cessation clinic completed questionnaires about 4 symptom clusters: alertness, craving, physical symptoms, and psychological symptoms. Questionnaires were completed daily for the first 2 weeks of abstinence. Results showed a strong diurnal variation in craving for cigarettes, with craving lowest early in the morning and increasing to a peak around 7:00 p.m. The onset of withdrawal syndrome was rapid with many symptoms appearing within 2 hr of withdrawal. Severity of all symptom clusters decreased the first week followed by leveling off or increase in

the second week. Smokers were divided into two groups: totally abstinent smokers and partially abstinent smokers who reduced their cigarette consumption by an average of 60%. The two groups reported similar levels of symptom severity, but the totally abstinent group experienced a notable decrease in symptoms during the first week, whereas the partially abstinent group maintained their withdrawal symptoms.

SILVERSTEIN R 217
CIGARETTEE SMOKING, NICOTINE ADDICTION, AND RELAXATION
JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY 42(5):946-950, 1982

In an attempt to explain the self-report of smokers that cigarette smoking is relaxing, shock endurance was used to measure amount of anxiety experienced in a stressful situation by nonsmokers, smokers who were allowed to smoke cigarettes containing either low or moderately high levels of nicotine, and smokers who were not allowed to smoke a cigarette. Pain threshold was defined as first shocks that subjects reported as painful. Cigarette smoking is calming; for the confirmed smoker, not smoking is upsetting. Smokers deprived of cigarettes or who smoked cigarettes containing low levels of nicotine behaved more anxiously than nonsmokers or smokers who smoked cigarettes containing moderately high levels of nicotine. High-nicotine smokers, however, behaved no less anxiously than nonsmokers. Personality questionnaires showed no differences between smokers and nonsmokers. The results support the hypothesis that the calming effect attributed to smoking a cigarette is due to the action of nicotine in ending withdrawal symptoms in addicted smokers rather than to a sedative property of cigarette smoking.

SINNOT J, LAUTH J E 254
EFFECT OF SMOKING ON TASTE THRESHOLDS
JOURNAL GENERAL PSYCHOLOGY 17:151-153, 1937

Threshold values for sugar and salt solutions were determined in subjects ($n = 6$) before they gave up smoking and during non-smoking intervals. Determinations were made by placing 3 cc of the test solution on the tongue. If the subject experienced no taste sensation, the mouth was rinsed with distilled water and the test repeated with a stronger solution. No individual mean of the non-smoking period exceeded the group mean of the smoking period. There was a rapid increase in the threshold after the subject began to smoke, followed by a decline when they quit. Determinations were repeated using nonsmokers ($n = 12$). Threshold values of nonsmokers indicated that 33% of the individual means of the nonsmokers exceeded the group mean of smokers during their non-smoking period. No significant difference was observed between the nonsmokers and the smokers during the non-smoking interval.

SMITH D L, TONG J E, LEIGH G 139
 COMBINED EFFECTS OF TOBACCO AND CAFFEINE ON THE COMPONENTS OF
 CHOICE REACTION TIME, HEART RATE, AND HAND STEADINESS
 PERCEPTUAL AND MOTOR SKILLS 45:635-639, 1977

Eight smokers were tested under six conditions comprising combinations of 200 mg caffeine or no caffeine with no cigarette, one 0.3-mg nicotine cigarette, or one 1.3-mg nicotine cigarette. Subjects performed a choice reaction-time task and a hand steadiness task. Heart rate was monitored throughout. Caffeine and nicotine both decreased decision time, but there was no drug interaction. Only caffeine improved motor time scores. Both drugs impaired hand steadiness, but there was no drug interaction. Each drug alone accelerated heart rate, but in combination the drugs appeared to have antagonistic effects. The amount of nicotine appeared to be what caused the effect of smoking on decision time.

SMITH J R, LANDAW S A 728
 SMOKERS' POLYCYTHEMIA
 NEW ENGLAND JOURNAL OF MEDICINE 298:6-10, 1978

Twenty-two polycythemic patients with elevated carboxyhemoglobin levels were studied to determine the relationship between their heavy smoking and polycythemia. Hemoglobin, hematocrit, red cell count, white cell count, and red cell indexes were measured. Red cell volume was increased in 14 of 18. Fatigue and headache were common, and mild to moderate hypertension was seen in seven patients. In five patients who markedly decreased their smoking habit, symptoms disappeared and the red cell volume decreased. Low plasma volume increased in three of four patients studied. It is concluded that carbon monoxide exposure from cigar or cigarette smoke is a frequent cause of an increased red cell volume and/or a decreased plasma volume.

SOGANI R K, JOSHI K C 130
 EFFECT OF CIGARETTE AND BIRI SMOKING & TOBACCO CHEWING ON BLOOD
 COAGULATION AND FIBRINOLYTIC ACTIVITY
 INDIAN HEART JOURNAL 17(3):238-242, 1965

The effect of cigarette and biri smoking and tobacco chewing on blood coagulation and fibrinolytic activity was studied in male volunteers, almost all of whom were accustomed to that particular mode of nicotine consumption. Eleven subjects consumed tobacco

in each form. After overnight abstinence, blood was collected for study, and the subject was asked to smoke two cigarettes or two biris or to chew a betel containing a moderate amount of flavored tobacco. Five minutes after completion of smoking or 20 minutes after the start of betel chewing, blood was again collected. The following studies were made: whole blood clotting time, recalcified plasma clotting time, prothrombin time, platelet adhesiveness, fibrinogen content, and fibrinolytic activity. Changes before and after tobacco consumption were seen in all tests performed, but only the effects on platelet adhesiveness and fibrinolytic activity were significant. An increased tendency to coagulation and decreased fibrinolytic activity were evident in all tests performed and with all three modes of tobacco consumption. Results are discussed in terms of the development of atherosclerotic lesions.

SOLDATOS C R, KALES J D, SCHARF M B, 809
 BIXLER E O, KALES A
 CIGARETTE SMOKING ASSOCIATED WITH SLEEP DIFFICULTY
 SCIENCE 207(4429):551-555, 1980

Five chronic cigarette smokers and five nonsmokers matched by sex and age were studied to determine the link between chronic smoking and sleep difficulty and whether abrupt withdrawal from cigarette smoking results in improved sleep. Comparison of sleep efficiency and sleep stage variables were monitored in a sleep laboratory. Results showed that smokers were awake for a longer time than nonsmokers primarily because they had greater difficulty falling asleep. In a second study, the sleep patterns of eight male smokers were recorded for the first five nights of abstinence from smoking and again on nights 15 and 16. For these subjects, both total time awake and sleep latency decreased and continued to do so after the extended abstinence period. Results from these two studies suggest that chronic smoking is associated with sleep difficulty and the improvement in sleep during abstinence from smoking can be explained by a decrease in catecholamine concentrations.

SOLOFF L A, FRANKL W S, WILSON G T T 804
 EFFECTS OF SMOKING ON CARDIAC OUTPUT, FREE FATTY ACIDS BLOOD
 PRESSURE AND CATECHOLAMINES IN HEALTHY YOUNG SUBJECTS DURING
 CARDIAC CATHETERIZATION
 PHARMACOLOGIST 7(2):149, 1965

It is known that smoking increases cardiac output, blood free fatty acids, blood pressure, and the release of catecholamines in normal resting man, but all of these effects are blocked by glucose. This study was done to determine if the stress of the

knowledge that these procedures are being performed is sufficient to block the effects of nicotine. Six healthy chronically smoking medical students were studied, and were informed when each procedure was occurring. Results showed no significant rise in cardiac output, stroke volume, free fatty acids, blood pressure, or catecholamines during or after smoking. These studies cast doubt on whether tobacco exerts any effect upon these parameters in the nonbasal state.

SONNENBERG A, HUSMERT N 64
EFFECT OF NICOTINE ON GASTRIC MUCOSAL BLOOD FLOW AND ACID
SECRETION
GUT 23(6):532-535, 1982

The effects of nicotine on gastric mucosal blood flow and acid secretion in 13 males were investigated. Doses were administered via intravenous nicotine infusion and cigarette smoking, with blood flow measured by gastric neutral red clearance. Nicotine increased volume secretion, acid secretion and neutral red clearance in a dose-dependent manner. Smoking five cigarettes elicited an effect similar to an intravenous dose of 5 ug/kg hr nicotine. Results seem to show that nicotine increases blood supply to the gastric mucosa relative to the increased action via other mechanisms than change in acid secretion and gastric mucosal blood flow.

SPEER F 543
TOBACCO AND THE NONSMOKER
ARCHIVES ENVIRONMENTAL HEALTH 16:443-446, 1968

In the present study, the effects of tobacco smoke on 191 allergic nonsmokers and 250 nonallergic nonsmokers were examined. Subjects from both groups were questioned about their reactions to the smoke of cigarettes, cigars, and pipes as encountered at home, at social occasions, in automobiles, and during business activities. Reactions to tobacco smoke included eye irritation, nasal symptoms, headache, cough, wheezing, sore throat, nausea, hoarseness, and dizziness. Of 191 allergic subjects, 140 complained of eye irritation; 137 of nasal symptoms; and 87 of headache. Of 250 nonallergic subjects, 139 complained of eye irritations, 73 of nasal symptoms, and 79 of headaches. It is concluded that the effects of tobacco smoke are irritative rather than allergic.

SQUIRES W G, BRANDON T A, ZINKGRAF S, BONDS D, HARTUNG G H,
MURRAY T 827
HEMODYNAMIC EFFECTS OF ORAL SMOKELESS TOBACCO IN DOGS AND YOUNG
ADULTS
PREVENTIVE MEDICINE 13(2):195-206, 1984

These cardiovascular effects of an oral smokeless tobacco product (snuff) were investigated in 20 young men and in 10 anesthetized dogs. Instrumented measurements were taken after the dogs were given a 2.5 g dose of moistened snuff. Increases were seen in heart rate, blood pressure, left ventricular pressure, left ventricular end diastolic pressure, and left ventricular dP/dt. Decreases in flow were noted in the coronary circumflex, renal, and femoral arteries. In the experiment using humans, subjects were given a 2.5 g dose of the same snuff product. For 20 minutes following baseline, increased heart rate and blood pressure was detected after oral smokeless tobacco in both humans and dogs. This hemodynamic response appears to be mediated by catecholamines.

STEIGMANN F, DOLEHIDE H, KAMINSKI L 268
EFFECTS OF SMOKING TOBACCO ON GASTRIC ACIDITY AND MOTILITY OF
HOSPITAL CONTROLS AND PATIENTS WITH PEPTIC ULCER
AMERICAN JOURNAL OF GASTROENTEROLOGY 22:628-632, 1954

After hospital controls (n = 44) smoked a standard cigarette, total gastric acidity increased 10-19 clinical units in 12 cases; 20-39 clinical units in 9; and 40-60 clinical units in 5 cases. After smoking a filter cigarette, total acidity increased 10-19 clinical units in 5 cases; 20-39 units in 3; and 40-60 in 2 cases. Following smoking of a standard cigarette, 50% of hospital controls had an increase in gastric acidity as compared to 25% of controls following smoking a filter cigarette. Of the peptic ulcer patients (n = 54), 4 had no gastric acidity increase following smoking a standard cigarette; 11 had a 10-19 clinical unit rise; 29 had 20-39 clinical unit increase; 9 had 40-60 clinical unit increase; and 1 an increase of 80 clinical units. After smoking a filter cigarette, 22 had no increase; 15 had a 10-19 clinical unit increase; 16 a 20-39 clinical unit increase; 1 a 40-60 clinical unit increase; while no patients had an increase over 60 clinical units. While twice as many hospital controls had no increase in gastric acidity following a filtered cigarette. For the gastric motility study, fundic and antral tracings were at variance. Smoking a standard cigarette decreased antral motility about 30% more often than a filter cigarette; while after two standard cigarettes, antral motility was decreased as frequently as after two filter cigarettes. Fundic motility showed less decrease from smoking than the antral motility. There is an increase in gastric acidity following smoking a cigarette in both hospital controls and peptic ulcer patients. This acidity increase is more frequent and in higher

ranges following a standard rather than a filter cigarette. Antral motility decreases more often following smoking a standard rather than a filter cigarette.

STERLING G M 576
MECHANISM OF BRONCHOCONSTRICTION CAUSED BY CIGARETTE SMOKING
BRITISH MEDICAL JOURNAL 3:275-277, 1967

Airway resistance and lung volume of 11 normal adults were tested on two occasions using the body plethysmograph. At the first session, measurements were taken before and 2-3 minutes after smoking a filtered cigarette (15 puffs over 5 minutes). At the second session, measurements were taken at rest, 25 minutes after subcutaneous injection of 1.2 mg atropine sulphate, and after smoking (as at the first session). Smoking produced a decrease in airway conductance that lasted 20-30 minutes at the first session. At the second session, conductance increased after injection of atropine, and smoking did not significantly affect this increase. Previous studies indicate that the bronchoconstriction caused by smoking is specifically due to the irritant action of smoke particles. How atropine prevents this effect is unclear, although it is suggested that vagal activity is involved.

STEVENS H A 550
EVIDENCE THAT SUGGESTS A NEGATIVE ASSOCIATION BETWEEN CIGARETTE SMOKING AND LEARNING PERFORMANCE
JOURNAL OF CLINICAL PSYCHOLOGY 32(4):896-898, 1976

Several control measures relevant to complex learning were taken. These included anxiety level and socioeconomic background assessments. Four standard learning measures were selected to represent an approximate hierarchy of learning complexity. These were, in ascending order of complexity, the Hunter-Pascal Concept Task (HP), the Wisconsin Card Sorting Test (WCST), the Standard Anagram Task (SAT), and the Word-in-Context Test (WINC). Analysis of the data indicated that there were no mean differences between smoker and nonsmoker groups on all control measures of anxiety and socioeconomic background. The nonsmoking subjects performed better than did smoking subjects on the SAT, WINC, and HP tests, but did not differ from the smoking subjects on the WCST. These results indicate that subjects who smoke do not perform as well on learning tests as do nonsmoking subjects. This disadvantage is related to degree of smoking rather than to smoking per se as the light-smoking group did as well as the nonsmoking group in this study. The effect of smoking on the learning process was detected only in the group of subjects who smoked in excess of 12 cigarettes per day. These results do suggest that smoking fewer than 13 cigarettes per day is measurably less harmful to the learning process than smoking, for example, 20 cigarettes per day.

STROMBLAD B C R 498
 EFFECT OF INTRA-ARTERIALY ADMINISTERED NICOTINE ON THE FLOOD
 FLOW IN THE HAND
 BRITISH MEDICAL JOURNAL 1:484-485, 1959

The effect of intra-arterial injection or intra-arterial infusion of nicotine on vasoconstriction in the hand was studied in 10 healthy subjects. The single injection of 100 ug of nicotine was followed by an immediate reduction in hand blood flow for all subjects. The 16.7 ug/min infusion rate caused vasoconstriction in three subjects and the 83.5 ug/min infusion rate resulted in vasoconstriction in four additional subjects. Four subjects remained unaffected by the latter infusion rate. A control injection of saline had no effect on vasoconstriction. Sensitivity to the vasoconstrictor effect of nicotine was not found to correlate with individual levels of habitual smoking which ranged from no smoking to smoking more than 30 cigarettes per day. Injections of hexamethonium bromide or pentolinium tartrate blocked the vasoconstrictor response to nicotine. Combined injections of dihydroergotamine and dibenzamine also blocked vasoconstriction, although dihydroergotamine by itself caused a reduction in blood flow. The vasoconstrictor effect of nicotine and its blockade by sympatholytic and sympathetic ganglion-blocking agents suggests that nicotine mediates vasoconstriction by acting directly on the peripheral sympathetic nervous system.

SULT S C 863
 THE EFFECTS OF CIGARETTE SMOKING ON PERCEPTION OF ELECTRICAL
 STIMULATION AND COLD PRESSOR PAIN
 DISSERTATION ABSTRACTS INTERNATIONAL 46(5-B):1702, 1985

The effects of cigarette smoking on 2 pain tasks (electrical stimulation and cold pressor) were assessed by 3 response measures: pain threshold, pain tolerance level, and McGill pain questionnaire scores. Results of tests indicated that cigarette smoking did not affect ratings of the 3 response measures for either the cold pressor or electrical stimulation tasks. The following conclusions were drawn from results from this study and previous studies: 1) Deprived smokers do not respond differently from nonsmokers to pain; 2) Cigarette smoking may lead to physiological changes (for example, norepinephrine and or beta endorphin release, or increased cortical arousal), which increase pain threshold if initial blood nicotine levels are high; 3) Cigarette smoking causes increase of pain tolerance if the smoking and pain procedures temporarily coincide and if initial

blood levels of nicotine are high; and 4) Stress of the experimental setting may lead to an increased urge to smoke if experimental sessions are conducted subsequent to stabilization of urine acidity or if the subject is not nicotine deprived. When subjects are prohibited from smoking, they seem to experience a further increase in anxiety leading to decreased pain tolerance.

SUTER T W, BUZZI R, BATTIG K 184
CARDIOVASCULAR EFFECTS OF SMOKING CIGARETTES WITH DIFFERENT
NICOTINE DELIVERIES
PSYCHOPHARMACOLOGY 80(2):106-112, 1983

The effect of smoking cigarettes with different nicotine deliveries on the subcutaneous blood vessels at different sites of the body was studied in 15 healthy female smokers. Individual puffing behavior, estimated mouth intake of nicotine, and some personality traits were taken into account. Vascular activity was measured on the palmar surface of the middle fingertip of the non-dominant hand, on the palmar surface of the second toe of each foot, and at the earlobe and forehead. Subjects were then asked to smoke four cigarettes, one every 20 min: a cigarette of their own brand, a cigarette with a nicotine yield of 0.4 mg (machine standard), sham smoking (puffing an unlighted cigarette), and a cigarette with 1.5 mg nicotine delivery. The heart increases were dependent on the individual mouth intake of nicotine. The smoking-induced decreases in the pulse amplitudes failed to show a dependency on the nicotine dose. However, the vasoconstrictive response to nicotine was considerable with the finger recordings, modest with the foot recordings, and absent with the forehead and ear recordings. Furthermore, the magnitude of this vascular response at the finger correlated positively with personality traits of neuroticism, suggesting an explanation for the poor correlations with the dose of nicotine.

SUTER W, BUZZI R, WOODSON P P, BATTIG K 149
PSYCHOPHYSIOLOGICAL CORRELATES OF CONFLICT SOLVING AND CIGARETTE
SMOKING
ACTIV NERVOUS SUPPLEMENT (PRAHA) 25(4):261-272, 1983

In this experiment, 28 men in an experimental group participated in three sessions involving three successive rows of STROOP stimuli presented in a spaced trial technique. This was to measure short-term, single stimulus-elicited responses, as monitored by polygraphic psychophysiological recording. Subjects smoked a 0.2 mg and a 1.2 mg nicotine cigarette between the second and third rows of stimuli, and were compared with a yoked-control group that smoked a 1.2 mg nicotine cigarette but did not respond to the stimuli. Results showed that heart rate

remained slower in the yoked than in the experimental group, and that heart rate and serial EEG measures showed some habituation in the experimental subjects. In addition, pronounced skin conductance and vasoconstrictive responses to the STROOP stimuli remained constant in the experimental group. Smoking appeared to neither impair nor improve STROOP performance.

SWINEFORD O, OCHOTA L 241
SMOKING AND CHRONIC RESPIRATORY DISORDERS: RESULTS OF ABSTINENCE
ANNALS ALLERGY 16:455-458, 1958

Chronic cough and other evidences of chronic lung disease after patients (n = 25) stopped smoking were studied by means of a clinical questionnaire. Cough, dyspnea on exertion, asthma, frequent colds, and hay fever were recorded 96 times. Undiagnosed chest pain was reported 11 times. Eleven of these symptoms disappeared entirely upon cessation of smoking. Forty-one symptoms (75%-90%) improved. In 15 of the 25 patients, respiratory improvement was attributed solely to abstinence from smoking. Non-specific irritation is a more important mechanism than specific allergic reaction.

SZANTO S 473
SMOKERS HYPOGLYCAEMIA
JOURNAL IRISH MEDICAL ASSOCIATION 232:P22-24, 1966

Twenty-six heavy smokers were asked to fast and refrain from smoking overnight. The next morning their blood sugar level was checked before and after smoking two cigarettes. Subjects (n = 12) showed no appreciable change after smoking, while 14 had an increase in blood sugar ranging from 8 to 22 mg/100 ml. After abstaining from smoking for 48 hours, their fasting blood sugar became lower and the hyperglycemic effect of two cigarettes more marked. Subjects (n = 2) in this group showed hypoglycemia-like features. The number of cases studied is too small to permit generalized conclusions.

TACHMES L, FERNANDEZ R J, SACKNER M A 673
 HEMODYNAMIC EFFECT OF SMOKING CIGARETTES OF HIGH AND LOW NICOTINE
 CONTENT
 CHEST 74:243-246, 1978

The dose-related hemodynamic effects of smoking low- and high-nicotine cigarettes were investigated in this study. The subjects were 5 men and 3 women ranging in age from 18 to 30, all smokers, who were free of cardiopulmonary symptoms. The smoking of one high-nicotine cigarette produced a peak increase in cardiac output of 32% above baseline, with the effect lasting 1 hour. Smoking a low-nicotine cigarette produced an increase of 13% above baseline, lasting only 5 minutes. The high-nicotine cigarette also caused a greater increase in systemic blood pressure than did the low-nicotine cigarette. Stroke volume remained relatively constant throughout. Thus, the magnitude and duration of the increased cardiac output were shown to be directly related to the nicotine content of the cigarettes smoked.

TAKAHASHI K, TAKAO I T, GOTOH K, MATSUKURA S, IMURA H 814
 EFFECTS OF CIGARETTE SMOKING ON CYCLIC AMP, CYCLIC GMP, DOPAMINE
 BETA-HYDROXYLASE, AND NICOTINE IN HUMAN PLASMA AND URINE DURING
 WATER DIURESIS
 LIFE SCIENCES 21(6):803-810, 1977

Effects of cigarette smoking on dopamine beta-hydroxylase (DBH) activity, cyclic AMP, cyclic GMP, and nicotine in plasma and urine during water diuresis were examined in 19 healthy men. The subjects each smoked three cigarettes within a 30-min period. After smoking, plasma DBH decreased and plasma cyclic AMP increased, followed by increases in urinary cyclic AMP and nicotine excretion. No significant change in either plasma or urinary cGMP was observed. These results seem to indicate that smoking causes remarkable changes of the internal milieu in man, as expressed by the changes in plasma and urinary cAMP, urine volume, and plasma DBH.

TAMINATO T, SEINO Y, GOTO Y, INOUE Y, MATSUKURA S, IMURA H 279
 CIGARETTE SMOKING INHIBITS ARGININE INDUCED INSULIN RELEASE IN
 MAN
 HORMONE METABOLISM RESEARCH 10:73-79, 1973

Study designed to investigate the effects of smoking on arginine-induced immunoreactive insulin and glucagon (IRI and IRG) secretion using arginine pulse method. Experiment performed after overnight fasting and abstinence from smoking. Arginine monochloride dissolved in 20 ml of distilled water was injected i.v. over 2 min (arginine pulse), and arginine pulses were

repeated 2 more times at 30-minute intervals. Within a week, the same subjects submitted to an arginine pulse test with smoking; 30 min after the first arginine pulse, subjects smoked 3 cigarettes (0.1 mg) for 30 min. Three arginine pulses administered in 30 min intervals evoked similar IRI and IRG responses with peak values not significantly different from each other. During smoking, blood glucose increased and the value obtained at 60 min was higher than that of 30 min. After smoking, IRI response elicited by the second challenge the arginine pulse was attenuated and peak value was lower than the first peak value before smoking. Diminution of IRI response might be caused by increased catecholamine known to inhibit IRI secretion. Direct inhibitory action of nicotine on pancreatic beta cells should not be ruled out.

TAVEIRA D A, SILVA A M, HAMOSH 110
 AIRWAY RESPONSE TO INHALED TOBACCO SMOKE: TIME COURSE, DOSE
 DEPENDENCE AND EFFECT OF VOLUME HISTORY
 RESPIRATION 41:96-105, 1981

The effects of smoking three cigarettes with different nicotine contents on airways resistance were studied. Thoracic gas volume (TGV), airways resistance (Raw), and maximum expiratory flow volume were measured puff-by-puff for each cigarette smoked. Raw increased with all brands of cigarettes after one puff, with the maximum effect reached after three puffs. Instantaneous flow at 50% of vital capacity decreased with high-nicotine cigarettes, but not so with low-nicotine cigarettes. Instantaneous flow at 75% of vital capacity increased 30 minutes after the low-nicotine cigarette was smoked. A deep inspiration prior to Raw measurement decreased by about one-third the bronchostrictor effect of cigarette smoke. It is concluded that the probable site of action by tobacco smoke is in the large and central airways. A delayed bronchodilation of the small airways after smoking a low-nicotine cigarette might represent a response usually masked by other long-acting components in smoke.

TAYLOR D H, BLEZARD R P 428
 THE EFFECTS OF SMOKING AND URINARY PH ON A DETECTION TASK
 QUARTERLY JOURNAL OF EXPERIMENTAL PSYCHOLOGY 31:635-640, 1979

This experiment studied the short-term effects of nicotine deprivation on performance on a detection task. Subjects were either nonsmokers or smokers who smoked more than 15 cigarettes a day. One hour before the task, subjects were given a dose that would increase or decrease the pH of their urine an amount sufficient to affect the rate of renal excretion of nicotine in the smokers. Smokers smoked a cigarette immediately before the task,

but smoking was not allowed during the task. The pH manipulation did not affect performance of nonsmokers, who improved steadily throughout the task. After 40 minutes on the task, deprived smokers improved less than nonsmokers, and smokers whose urine had been made acid (increased rate of nicotine excretion) had improved less than smokers whose urine had been made alkaline (more conservation of plasma nicotine). Thus, the small degree of nicotine deprivation did cause deterioration in performance, a finding that has consequences for theories of nicotine dependence.

THOMAS C B 525
THE RELATIONSHIP OF SMOKING AND HABITS OF NERVOUS TENSION
IN: SMOKING BEHAVIOR: MOTIVES AND INCENTIVES, DUNN W L, ED.,
WASHINGTON, DC, WINSTON AND SONS, 1973, PP. 157-170

In this study, smoking behavior of medical students over a 17-year interval was related to habits of nervous tension, habits of daily life, and other psychobiological characteristics. Each student completed a Habit Survey, a Family Attitude Questionnaire, and a battery of physiological tests. Lifetime smokers showed the lowest scale scores for anxiety, anger, and depression compared to cigarette smokers. Number of cups of coffee per day and alcohol frequency had the most discriminating power. When smokers were dichotomized into heavy and light on the basis of number of cigarettes smoked daily before age 30, strikingly different psychological profiles for the 2 groups emerged. Heavy smokers had higher mean values for all 10 psychological variables. Anger was associated with heavy smoking. Feelings related to depression and tiredness on waking were reported in youth more frequently by heavy smokers than by light smokers. Heightened awareness of nervous tension, particularly feelings of anger and anxiety, appears to lead to increased use of cigarettes, coffee, and alcohol.

THOMAS C B, BATEMAN J L, LINDBERG E F 509
OBSERVATIONS ON THE INDIVIDUAL EFFECTS OF SMOKING ON THE BLOOD
PRESSURE, HEART RATE, STROKE VOLUME, AND CARDIAC OUTPUT OF
HEALTHY YOUNG ADULTS
ANNALS OF INTERNAL MEDICINE 44:874-892, 1956

After being weighed and measured, the subject lay on the ballistocardiographic table with feet in good contact with the footboard. Mean measured parameters changed from control values by the following amounts after the first cigarette: systolic pressure +2.9, diastolic pressure +4.6, pulse pressure -1.7, heart rate +6.6, stroke volume -4.0, cardiac output +373, and cardiac index +0.19. These parameters changed after the second

cigarette the following amounts: -0.5, -0.2, -0.3, +0.3, -1.1, -29, and -0.01. Systolic pressure increased more in women than in men. Pulse pressure decreased more in men than in women. There were no significant differences to be found between smokers and nonsmokers. Subjects with parental hypertension showed a greater increase in cardiac output and cardiac index than did subjects with negative parents. Subjects with parental coronary artery disease showed a much smaller increase in cardiac output and cardiac index than did subjects with negative parents. Changes occurred in all measurements following the smoking of one cigarette.

THOMAS C B, BATEMAN J L, LINDBERG E F, BORNHOLD H J 510
OBSERVATIONS ON THE INDIVIDUAL EFFECTS OF SMOKING ON THE BLOOD
PRESSURE, HEART RATE, STROKE VOLUME AND CARDIAC OUTPUT OF HEALTHY
YOUNG ADULTS
ANNALS INTERNAL MEDICINE 44:874-892, 1955

Ballistocardiograph tests were carried out on 113 subjects to determine the effects of cigarette smoking on blood pressure, heart rate, stroke volume and cardiac output in healthy young adults. Measurements were taken during and after the smoking of two cigarettes. On the average, systolic pressure, diastolic pressure, heart rate, cardiac output and cardiac index increased following smoking, while blood pressure narrowed and stroke volume diminished. Subjects with parental hypertension showed a greater increase in cardiac output and cardiac index than did subjects with negative parents. Likewise, subjects with parental coronary artery disease showed a much smaller increase in cardiac output and cardiac index than did subjects with negative parents. It is emphasized that there is no universal pattern of circulatory response to smoking.

THOMAS C B, MURPHY E A 486
THE CIRCULATORY RESPONSE TO SMOKING
JOURNAL OF CHRONIC DISEASES 8:202-229, 1958

This study was conducted to determine reproducibility of results and need for standardization in tests of circulatory response to smoking. Compared with light smokers, heavy smokers tended to have lower control values and greater response to smoking. The findings indicate that the ballistocardiographic smoking test gives results that are sufficiently reproducible to use for screening young adults according to circulatory reactivity. Attempts to standardize test conditions have little effect on results except that the fasting state tends to be associated with more marked response.

TIBBLING L 54
 THE INFLUENCE OF TOBACCO SMOKING, NICOTINE, CO, AND CARBON
 DIOXIDE ON VESTIBULAR NYSTAGMUS
 ACTA OTO-LARYNGOLOGICA 68:118-126, 1969

Rotatory nystagmus and venous carboxyhemoglobin (COHb) levels were studied. I.v. nicotine increased nystagmus frequency from 2.3 beats/sec to 4.9 beats/sec. Inhalation of carbon dioxide decreased the nystagmus frequency from a mean of 2.8 beats/sec before inhalation to 2.5 beats/sec after. The recorded control of head movements showed that no changes of head position took place during the vestibular tests. The influence of smoking on heart rate (HR) varied proportionally to the influence on the nystagmus pattern. After a nicotine cigarette, HR increased from a mean of 81 to 109 bpm (+ 35%), and from 75 to 83 bpm (+ 11%) after i.v. nicotine. Smoking a nicotine-free cigarette caused an increase in COHb concentration. The carbon dioxide inhalation increased HR from 76 to 86 bpm (+ 13%). The influence of cigarette smoking on vestibular nystagmus pattern frequency failed to appear. There is increase in COHb content after smoking a conventional and after a nicotine-free cigarette. Increase in COHb is not responsible for the change in vestibular nystagmus pattern induced by tobacco smoking. The nystagmus pattern is uninfluenced even before the PCO₂ returns to normal. Neither the carbon dioxide content of tobacco smoke, nor an increase in cerebral blood flow is responsible for the nystagmus after smoking.

TIBBLING L, HENRIKSSON N G 55
 EFFECT OF CIGARETTE SMOKING ON THE VESTIBULAR NYSTAGMUS PATTERN
 ACTA OTO-LARYNGOLOGICA 65:518-526, 1968

Subjects smoked a nonfiltered cigarette at the rate of one deep inhalation every 15 sec for 3 min, and each subject was repeated after an interval of 4-21 days. Amplitude, frequency, speed of slow component, speed of fast component, and angular deviation of eyes were measured following rotation. Frequency showed the greatest change; heavy smokers had the smaller change. Speed of the fast component decreased after smoking.

TOBIN M J, JENOURI G, SACKNER M A 65
 EFFECT OF NICOTINE ON CHANGE IN BREATHING PATTERN WITH SMOKING
 CHEST 82:5, 530-537, 1982

Two experiments were conducted to study whether release of endorphins might be related to decreases in inspiratory flow rate after smoking. In the first experiment, 14 smokers received an injection of placebo, smoked a cigarette, 50 minutes later received an injection of naloxone, and smoked a cigarette.

During smoking, mean inspiratory flow increased for both conditions. After smoking, an increase occurred for 11 of 14 subjects given naloxone, but for only 5 of 14 subjects given placebo. Eleven of the 14 subjects showed higher mean inspiratory flow rate after naloxone than after placebo. The group means after smoking showed a decrease in rate with placebo and an increase with naloxone. In the second experiment, 10 subjects were given i.v. injection of either placebo or naloxone. There were no differences in inspiratory flow rate between conditions or before and after drug administration. These results indicate that nicotine often causes release of endorphins that may blunt respiratory drive. Naloxone can block this effect.

TONG J E, BOOKER J L, KNOTT V J 551
EFFECTS OF TOBACCO TIME ON TASK AND STIMULUS SPEED ON JUDGMENTS
OF VELOCITY AND TIME
PERCEPTUAL AND MOTOR SKILLS 47:175-178, 1973

The subject estimated when the "traversing" stimulus light would have reached the "target" light. The mean velocity judgments were all underestimates and mean time judgments were all overestimates except for the first block under tobacco treatment for all three stimulus speeds. Increased "traverse" velocity led to proportionally less underestimation. Greatest underestimation occurred under treatment for the slowest speed. Greatest accuracy (less underestimation smoking) occurred with no smoking for the fastest speed. Traverse time scores showed that subjects overestimated in all conditions except under smoking treatment with the slowest speed. All scores decreased, but increased "traverse" velocity proportionally increased overestimation. Greatest overestimation occurred in the no smoking condition with the fastest velocity. Underestimation occurred at slowest velocity under the smoking condition. Absence of consistent correlations between the two scores suggests that the two tasks did not tap one common underlying mechanism. Although smoking interacts with stimulus velocity and time on task to influence judgment of velocity, the effect is less profound than for time reproduction. In both instances, influence of tobacco was less in the latest part of the task, corresponding with rapid dissipation of nicotine in the nervous system.

TONG J E, KNOTT V J, MC GRAW D J, LEIGH G 561
ALCOHOL VISUAL DISCRIMINATION AND HEART RATE, EFFECT OF DOSE
ACTIVATION AND TOBACCO
QUARTERLY JOURNAL STUDIES ON ALCOHOL 35:1003-1022, 1974

The purpose of the present study was to examine how smoking affects the results of ethanol-behavior research. Subjects were eight nonsmokers and eight smokers. Nonsmokers were tested under

three treatments; no alcohol, 0.020% blood alcohol concentration (BAC), and 0.088% BAC. For smokers, these treatments were combined with smoking no cigarettes or two cigarettes. Smokers showed effects of both drugs on heart rate and tobacco increased both TFF sensitivity and TFF criterion. Nonsmokers showed increased heart rate from the low to high dose of alcohol and higher TFF threshold after alcohol than after placebo. Nonsmokers given the placebo had higher TFF sensitivity than smokers who did not smoke. Although alcohol generally had a depressant effect on TFF sensitivity, tobacco reversed this trend at the high-dosage level. These results show that tobacco can confound results in alcohol research because of the stimulant effects of smoking.

TONG J E, LEIGH G, CAMPBELL J, SMITH D 49
TOBACCO SMOKING, PERSONALITY AND SEX FACTORS IN AUDITORY
VIGILANCE PERFORMANCE
BRITISH JOURNAL PSYCHOLOGY 68:365-370, 1977

A group of 120 students were tested to determine the influence of cigarette smoking, personality, and sex on their performance of a 60-minute auditory vigilance task. Subjects were divided into equal groups of nonsmokers, smokers not smoking, and smokers smoking. Each group was further divided by sex. Results showed that while nonsmokers detected fewer signals as the test progressed, smokers smoking increased their number of detections. Extroverted nonsmokers had higher scores than introverted nonsmokers, with the converse being true for smokers. It is concluded that smoking can be an important influence on tasks requiring sustained attention.

TROEMEL R G, DAVID R T, HENDLEY C D 343
DARK ADAPTATION AS A FUNCTION OF CAFFEINE AND NICOTINE
ADMINISTRATION
PROCEEDINGS SOUTH DAKOTA ACADEMY SCIENCES 30:799-784, 1951

Dark adaptation was measured on a Hecht-Shalaer adaptometer in control and experimental sessions separated by 15-minute intervals following light adaptation. Nicotine was inhaled during light adaptation for experimental component. Dosage of nicotine was low (1 inch of a standard brand cigarette smoked in 2 minutes) or heavy (1 inch of two cigarettes smoked consecutively in 2 minutes each). Nicotine increased speed of dark adaptation in the absence of caffeine (0.1% confidence level). A small dose of caffeine, 3 grains, in combination with nicotine did not antagonize the effects of nicotine. High doses of caffeine (6 grains) in combination with nicotine showed speeding of dark

adaptation as with nicotine alone. The faster course of dark adaptation with nicotine alone may be explained by nicotine action in releasing glycogen and thus facilitating physio-chemical changes of dark adapting.

VOGEL W, BROVERMAN D, KLAIBER E L 93
ELECTROENCEPHALOGRAPHIC RESPONSES TO PHOTIC STIMULATION IN
HABITUAL SMOKERS AND NONSMOKERS
JOURNAL OF COMPARATIVE AND PHYSIOLOGICAL PSYCHOLOGY 91:418-422,
1977

EEG driving response, defined as EEG waves at fundamental or harmonic frequency of photic stimulation for 1 sec, was scored as present or absent. Difference between mean score before and after smoking occurred in smokers and nonsmokers. Mean score decreased in smokers by 2.44 responses compared to 0.95 response in nonsmokers. Central adrenergic stimulation by nicotine of smokers experiencing tranquilizer effects (Nesbitt's paradox) may be related to central adrenergic insufficiency in smokers.

WALKER J M 883
THE EFFECT OF SMOKING ON WATER DIURESIS IN MAN
QUARTERLY JOURNAL MEDICINE 18:51-59, 1948

To study the effect of smoking on water diuresis, chloride excretion and posterior lobe hormone liberation were measured and response to injections of morphine and nicotine were observed. Of 13 subjects, 7 had an inhibition of diuresis after 1 cigarette and 6 subjects after 2. Most of those in the 1 cigarette group were nonsmokers. The total chloride was estimated for 2 subjects and, in both cases total chloride excretion increased. When nicotine acid tartrate was administered intravenously to 3 subjects, 1.6 to 3.0 mg was needed to inhibit diuresis, and this was accompanied by an increase in total chloride excretion. Injections of 50 milliunits of posterior lobe pituitary, which were given to 6 subjects resulted in a period of inhibition similar to that of smoking 2 cigarettes. Injections of 20 mg of morphine sulfate, which were given to 7 subjects, did not inhibit diuresis. Because nausea occurred with both morphine and nicotine injections, the inhibition of diuresis does not seem related to a nonspecific effect of nausea. These results show that 1 or 2 cigarettes cause an inhibition of water diuresis.

WALSH J A, LUDBROOK J, VINCENT A H 800
THE EFFECTS OF TOBACCO SMOKING, INTRAVENOUS NICOTINE AND CERTAIN
OTHER PROCEDURES ON THE RESPONSE OF HAND BLOOD FLOW TO DISTANT
ICE APPLICATION
PROCEEDING AUSTRALIAN PHYSIOLOGY PHARMACOLOGY SOCIETY
4(2):175-176, 1973

The purpose of this experiment was to determine if tobacco smoking potentiates the vasoconstrictor response of hand resistance vessels to distant ice application (to the neck). Inhalation of tobacco smoke (three times per minute for 7 minutes) decreased the ice response compared with the control response. Sham smoking, intravenous administration of nicotine (200, 400, or 600 ug/min for 10 minutes), a foot movement procedure, and mental arithmetic also had this inhibitory effect. Only imaginary smoking failed to decrease the ice response. Possibly a common central inhibitory action at a cortical level is responsible for the inhibitory effect of the various procedures.

WALSH C H, WRIGHT A D, ALLBUTT E, POLLOCK A 474
 THE EFFECT OF CIGARETTE SMOKING ON BLOOD SUGAR, SERUM INSULIN AND
 NON ESTERIFIED FATTY ACIDS IN DIABETIC AND NONDIABETIC SUBJECTS
 DIABETOLOGIA 13:491-494, 1977

The effect of smoking on plasma glucose levels, free fatty acids, cholesterol, and triglycerides and plasma serum levels of insulin was studied in 10 diabetic and 18 nondiabetic smokers. Following oral glucose challenge, blood samples were taken at 30-min intervals for 2 hrs during which subjects either did not smoke or smoked 4 cigarettes containing 1.2 mg of nicotine each. No significant differences were found between the smoking and non-smoking conditions for any of the blood measures for either subject group. It is concluded that smoking does not impair carbohydrate metabolism and that the diagnostic value of the glucose tolerance test is not negatively influenced by cigarette smoking in habitual smokers.

WARREN C P W, HOLFORD-STREVEVS V, WONG C, MANFREDA J 760
 THE RELATIONSHIP BETWEEN SMOKING AND TOTAL IMMUNOGLOBULIN E
 LEVELS
 JOURNAL ALLERGY CLINICAL IMMUNOLOGY 69(4):370-375, 1982

To study the effect of smoking on the immune system, the relationship between smoking and serum IgE levels was investigated. Skin tests, total serum IgE levels, and a respiratory questionnaire were used with 1,768 subjects, including smokers and nonsmokers. For subjects who had no skin test reactions or history of asthma or hayfever, the geometric mean total IgE levels were 14.3 U/ml for men and 11.9 U/ml for women. IgE levels among nonsmokers, ex-smokers, and smokers varied when skin reactivity and smoking history were considered. The percentage of subjects with elevated total IgE was higher in smokers than in nonsmokers regardless of skin reactivity. Although the IgE levels were higher in smokers than nonsmokers, there was no relationship between intensity of smoking and IgE levels. These results confirm the association between smoking and elevated levels of serum IgE.

WARWICK K M, EYSENCK H J 552
 EXPERIMENTAL STUDIES OF THE BEHAVIORAL EFFECTS OF NICOTINE
 PHARMAKOPSYCHIATRIE NEURO-PSYCHOPHARMAKOLOGIE 1:145-169, 1968

Tests were presented in a fixed order: motor steadiness, Archimedes' spiral after-effect, visual masking, CFF threshold, and two-flash threshold. In all cases of motor steadiness tests, the drug and no-drug groups tended to be similar, whereas the placebo group showed a greater motor steadiness than the other 2 groups. A test that measured duration of spiral rotation after-effects showed no significant differences between smokers and nonsmokers. In the case of serial reaction time performance, nicotine interfered with normal improvement of performance after practice. Visual masking, measured by tachistoscope that covered the range 300 usec to 1.5 sec, showed that nicotine produced greater visual masking threshold in nonsmokers than smokers; placebo and no drug conditions produced effects opposite to nicotine wherein visual masking threshold were lower in nonsmokers than smokers. In evaluation of critical flicker fusion threshold (CFF) there was an effect of nicotine that increased CFF threshold. Two-flash threshold analysis showed no significant differences between groups. Results substantiated the hypothesis that nicotine in small doses increased cortical arousal.

WARWICK K M, EYSENCK H J 519
 EXPERIMENTAL STUDIES OF THE BEHAVIORAL EFFECTS OF NICOTINE: II
 INTERACTION OF SEX AND SMOKING HABITS
 PHARMAKOPSYCHIATRIE NEURO-PSYCHOPHARMAKOLOGIE 2:217-222, 1969

Significance of the independent variables of sex and smoking habits in determining the effects of nicotine on behavior were evaluated. Data from 6 experimental tests were analyzed. Results from the serial reaction time, spiral after-effect, visual masking, and CFF tests failed to show differences in male or female responsiveness. Although reminiscence scores in the serial reaction time test appeared to support the hypothesis of greater drug effects for women, scores on the tremor test (frequency of touching) were contradictory. Differences in response between smokers and nonsmokers in the serial reaction time, spiral after-effect, and visual masking tests were not observed. While differences were greater for nonsmokers in the ascending threshold test, only the smokers showed the predicted decrease of thresholds (due to a cross-over of drug scores). Test results indicate that the effects of sex and smoking history are too complex to formulate a hypothesis.

WARWICK K M, EYSENCK H J 310
 THE EFFECTS OF SMOKING ON THE CFF THRESHOLD
 LIFE SCIENCES 4:219-225, 1963

CFF thresholds were determined in men ($n = 9$; 5 smokers, 4 non-smokers) when nicotine was administered through smoking a cigarette in Experiment 1 or administered to subjects ($n = 3$, groups of 5) orally (0.1 mg) in Experiment 2. Each subject was dark-adapted for 15 min. After the subject's eye was light-adapted to the test luminance for 1.5 min, CFF threshold was measured. The only significant change in the CFF threshold was for smokers who abstained 12 hrs from smoking before the test. The nicotine effect lasted about 15 min. Effects of smoking in non-smokers were nonsignificant. In Experiment 2, the light source had intensity about 2 times that in Experiment 1. Subjects were tested under nicotine, placebo, and no-drug conditions. None of the subjects smoked before the test. Increases in the CFF threshold due to nicotine were significant when comparing drug and placebo groups and significant when comparing the drug versus no-drug groups. These experiments support the hypothesis that nicotine is a stimulant drug.

WEATHERBY J H 511
 SKIN TEMPERATURE CHANGES CAUSED BY SMOKING AND OTHER
 SYMPATHOMIMETIC STIMULI
 AMERICAN HEART JOURNAL 24:17-30, 1942

Skin temperatures in the morning, 8-10 hr after the last smoke, frequently were lower than those in the afternoon, only 1 hr after the last smoke. Smoking of a cigarette (with inhalation) by one accustomed to their use results in the following changes: systolic blood pressure was increased 10-25 mm Hg in most subjects; diastolic blood pressure was increased, although in some instances the increase was greater, which resulted in decreased pulse pressure; heart rate was increased 5-20 beats/min (in the hypersusceptible subject the increase may be as much as 30); skin temperature of the finger drops 2-5 C; and skin temperature of the toe drops 3-7 C. When the room temperature was increased to 29-30 C, finger temperature decreased 0.5 C and toe temperature decreased 1.5 C after smoking 1 cigarette. A second cigarette caused no greater change. Thus, the positive vasodilator stimulus of a 29-30 C room temperature was sufficient to inhibit the vasoconstrictor influence of smoking. Effects on blood pressure, heart rate, and skin temperature of smoking a nicotine-free cigarette (with inhalation) by a habitual smoker were similar to effects of an ordinary cigarette when the smoke was not inhaled; blood pressure and heart rate showed no significant change, and skin temperature decreased only a degree. Various

physiologic and psychic stimuli, such as reading, talking, sudden noises, drinking cold water, and hyperventilation, may cause changes in skin temperature comparable to those produced by smoking. Mild physical activity, even at relatively low atmospheric temperatures, inhibits the decrease in skin temperature after smoking.

WEBER A, FISCHER T, GRANDJEAN E 544
 PASSIVE SMOKING: IRRITATING EFFECTS OF THE TOTAL SMOKER
 AND THE GAS PHASE
 INTERNATIONAL ARCHIVES OF OCCUPATIONAL AND ENVIRONMENTAL HEALTH
 43:183-193, 1979

Subjects (3 women and 29 men, 7 smokers and 25 nonsmokers, 19-24 yr old) were exposed in 1 experiment to the gas phase of cigarette smoke with particulate matter removed, and in another experiment to the total sidestream smoke. Air pollution was simulated at 10 ppm CO in both experiments. The concentrations of particulate matter (CO, NO, and NO₂) were constant in both phases, however, HCHO concentration was 160 ppm in the gas phase. Eye blink rate of each subject was measured during 1.5 min using a video system. Both exposures of air pollution produced nearly the same degree of annoyance, indicating that the gas phase is largely responsible for the annoyance due to cigarette smoke. Subjective eye irritation and eye blink rate were much lower with the gas phase than with the total smoke. Irritations of nose and throat were also higher with the total smoke than with the gas phase alone. The particulate phase is largely responsible for the irritating effects of cigarette smoke.

WECHSLER R L 344
 EFFECTS OF CIGARETTE SMOKING AND INTRAVENOUS NICOTINE ON THE
 HUMAN BRAIN
 FEDERATION PROCEEDINGS 17:169, 1958

The effects of cigarette smoking and intravenous nicotine on the human brain were studied using the electroencephalogram and the nitrous oxide method to measure cerebral circulation and metabolism. Electroencephalograms made before, during, and for 10 min after smoking revealed an intermittent flattening lasting 1-30 sec. This pattern occurred primarily with puffing on the cigarette, but it also occurred to a lesser degree in subjects who did not inhale and in those smoking filtered and denicotinized cigarettes. This pattern could be an abnormal attention response. Five men (19-22 years of age) were studied before and during the last 10 minutes of the administration of 8-10 mg of nicotine base given over a 30-min period. Dizziness, nausea, and ache in the infusion arm, numbness, shaking, and cold extremities

occurred. Anxiety, tachycardia, and hyperventilation with a decrease in pCO_2 and an increase in cerebral metabolism were noted in three subjects. Because of the side reactions, it is difficult to attribute the observed significant increase in cerebral metabolism (4.0-6.0 cc/100 gm/min) to nicotine.

WESNES K, REVELL A 182
THE SEPARATE AND COMBINED EFFECTS OF SCOPOLAMINE AND NICOTINE ON
HUMAN INFORMATION PROCESSING
PSYCHOPHARMACOLOGY (BERLIN) 84(1):5-11, 1984

Subjects were instructed to press a response button when sequences of 3 consecutive odd or three consecutive even digits appeared. Compared to placebo, nicotine (1.5 mg) increased the probability of detection, decreased reaction time, and decreased detection errors. Scopolamine (1.2 mg) decreased the probability of detection, increased reaction time, and decreased errors slightly. Nicotine and scopolamine in combination showed results similar to placebo, suggesting antagonistic effects. The Stroop test was given following a 2.5 hr rapid information processing test session similar to test described above. Compared to placebo, nicotine (1.5 mg) increased the probability of detection in the first test interval (70-85 min) and decreased probability of detection in the second test interval (140-155 min). Nicotine increased errors in both intervals. Scopolamine (1.2 mg) decreased the probability of detection in both intervals, increased reaction time, and increased errors in the second interval only. Nicotine and scopolamine in combination produced effects similar to placebo. Stroop test revealed that subjects were slower following scopolamine than placebo, nicotine, and nicotine/scopolamine combination. Compared to placebo and scopolamine alone, nicotine and nicotine/scopolamine combination showed more rapid information processing. These studies suggest that nicotine antagonizes the performance decrements associated with scopolamine.

WESNES K, Warburton D M 174
EFFECTS OF SMOKING ON RAPID INFORMATION PROCESSING PERFORMANCE
NEUROPSYCHOBIOLOGY 9:223-229, 1983

The effects of smoking cigarettes of varying nicotine delivery and tar levels on both accuracy and speed of target detection were studied in two experiments. The information processing task consisted of the detection of sequences of three consecutive odd or even digits from a series of digits presented visually at the rate of 100/min. In the first experiment, smoking improved both the speed and accuracy of performance above rested baseline levels, the greatest improvement occurring with the highest

nicotine and tar delivery cigarette. In the second experiment, 6 male and 6 female subjects smoked a nicotine-free cigarette and two cigarettes with nicotine deliveries of 0.6 and 1.84 mg with covarying tar yields of 7 and 27 mg, respectively. In an additional experimental session, no cigarette was smoked. Smoking improved the speed and accuracy of performance above baseline levels, while performance deteriorated over time after not smoking, as well as after smoking a nicotine-free cigarette. It is concluded that smoking produces absolute improvements in performance. The findings are explained in terms of the action of nicotine on central cholinergic pathways.

WESNES K, WARBURTON D M 183
EFFECTS OF SCOPOLAMINE AND NICOTINE ON HUMAN RAPID INFORMATION
PROCESSING PERFORMANCE
PSYCHOPHARMACOLOGY 82:147-150, 1984

Twelve nonsmokers were tested on a rapid visual information processing task identifying and responding to consecutive odd digits in a series presented at 100 digits/min to determine the effects of nicotine and scopolamine on performance. In the first experiment, after a 10 min baseline test, subjects received oral doses of either placebo, methscopolamine 1.2 mg, scopolamine 0.6 mg, or scopolamine 1.2 mg. Following scopolamine 1.2 mg, correct detections were decreased. No such decrement was observed in the other three conditions. In the second experiment, subjects received oral doses in tablet form of nicotine 0.5 mg, nicotine 1.0 mg, nicotine 1.5 mg, or a placebo. Post-drug testing was carried out 10 min after baseline, due to the faster absorption of nicotine. Nicotine helped prevent the decline in both speed and accuracy which occurred over time in the placebo condition. These findings suggest an important role of central cholinergic pathways in the performance of tasks having minimal memory requirements, but depending heavily on the efficient selection and processing of information. Compounds with opposite effects on central cholinergic pathways produce opposite effects on task performance.

WESNES K, WARBURTON D M, MATZ B 175
EFFECTS OF NICOTINE ON STIMULUS SENSITIVITY AND RESPONSE BIAS ON
A VISUAL VIGILANCE TASK
NEUROPSYCHOBIOLOGY 9(1):41-44, 1983

Subjects were 13 males and 18 females given either placebo, 1 mg, or 2 mg nicotine tablets; subjects abstained from alcohol, tobacco, coffee, and tea for 12 hrs. Signal detection analysis was used to examine effects of nicotine on a visual vigilance task of 80 min duration on 3 separate trials receiving different

doses of nicotine each time. Nicotine tablets of each strength were administered at 20, 40, and 60 min during a continuous clock task to observe the hands of a clock as they passed through a series of black and white sectors and to detect a brief pause in movement and press a button when the hand entered the black sector. Stimulus sensitivity decreased over time with placebo and had no effect on response bias. Nicotine antagonized the decrease in stimulus sensitivity observed with placebo.

WEST R J, JARVIS M J, RUSSELL M A H, CARRUTHERS M E, FEYERABEND C
222
EFFECT OF NICOTINE REPLACEMENT ON THE CIGARETTE WITHDRAWAL
SYNDROME
BRITISH JOURNAL ADDICTION 79:215-219, 1984

In the first session, subjects were asked to chew two pieces of their allocated gum per day for the following week while continuing to smoke as usual. The purpose was to enable them to get used to the gum before having to abstain from smoking. The 2 mg gum was the normal commercial preparation with an alkaline buffer to facilitate absorption through the buccal mucosa. The 0.5 mg gum has no buffer and gave some of the "sharpness" and taste of the standard gum but little or no pharmacological replacement (i.e., it acted as a placebo). There were no nicotine gum groups as far as mean age, daily cigarette consumption, and preabstinence values of expired air CO, peak plasma nicotine, and trough plasma nicotine. Following 24-hr abstinence, differences were noted between the two groups for depression, irritability, sociability, and composure in company. The mean drop in heart rate was 14.4 beats/min for 0.5 mg gum but only 9.7 beats/min for 2 mg gum. Skin temperature rose 0.94 C in the 0.5 mg group compared to only 0.03 C in the 2 mg gum group. (The difference was not significant.) This study supported the view that nicotine deprivation plays a major role in cigarette withdrawal syndrome, and that nicotine replacement at the relatively low level of 2 mg nicotine chewing gum helps to alleviate the problem.

WEST R J, RUSSELL M A, JARVIS M J, FEYERABEND C 147
DOES SWITCHING TO AN ULTRA LOW NICOTINE CIGARETTE INDUCE NICOTINE
WITHDRAWAL EFFECTS?
PSYCHOPHARMACOLOGY, 84:120-123, 1984

The effects of switching to ultra-low yielding cigarettes (0.1 mg) was studied on 26 smokers. One group continued smoking their usual brand while the other group switched to a low-yield cigarette. Switching to low yield cigarettes led to decreased mean HR (6 bpm compared to 0.2 bpm) in the usual brand group; an increase in skin temperature of 1.8 C in both groups; increase in

reported hunger (while in usual brand group a decrease); increased reports of feeling at loose end, (baseline value in this group was lower than in usual brand group). Resting HR, finger skin temperature, and urinary concentration were measured. HR and epinephrine levels decreased while skin temperature increased. ECO (expired air carbon monoxide), plasma nicotine, peak nicotine, and trough values were measured. Switching to lowest yield cigarettes resulted in a 60% decrease in nicotine, HR and CO intake associated with increased hunger, no deterioration in mood, and lack of satisfaction at first becoming more satisfying over 10 days. Other common cigarette withdrawal symptoms, irritability, depression, inability to concentrate, were not detected.

WHELAN R F 80
ALCOHOL NICOTINE AND MAN
MEDICAL JOURNAL OF AUSTRALIA 1:77-83, 1968

Changes in forearm blood flow measured qualitatively (by oxygen saturation) and also quantitatively started at 3 ml/100 ml/min, control mean; decreased to 2 ml/100 ml/min at 5 min after 2 cigarettes; then increased to a peak of 5.5 ml/100 ml/min at 10-15 min. Changes in hand blood flow started at 8 ml/100 ml/min (control mean); decreased to 2.5 ml/100 ml/min at 5 min after 2 cigarettes; then increased to a peak of 22.5 ml/100 ml/min at 7.5 min. Following intra-arterial injection of nicotine, percentage of oxygen saturation of blood from cutaneous veins of forearm and blood flow showed artifacts at 5-10 min. Injection of nicotine (i.a.) produces initial vasoconstriction associated with pain followed by vasodilation of 15-45 min duration.

WHITE J R, FROEB H F 577
SMALL AIRWAYS DYSFUNCTION IN NONSMOKERS CHRONICALLY EXPOSED TO
TOBACCO SMOKE
NEW ENGLAND JOURNAL MEDICINE 302:720-723, 1980

Spirometric tests were performed to compare pulmonary function in 2100 middle-aged subjects who were noninhaling smokers, light smokers, moderate smokers, heavy smokers, nonsmokers not exposed routinely to tobacco smoke at home or work, and passive smokers, nonsmokers who had been routinely exposed to tobacco smoke at their place of employment for 20 years or more. Comparisons made on subjects in these six groups revealed that nonsmokers chronically exposed to tobacco smoke had lower forced mid- and end-expiratory flow rates than nonsmokers not exposed. Spirometric values for the passive smokers were not significantly different from those of light smokers and noninhaling smokers. Finally, the degree of pulmonary function abnormality was found to be

associated with the extent of smoke exposure. Nonsmokers in smoke-free work environments had the highest spirometric values. The passive smoker, noninhaling smoker, light smoker, and heavy smoker groups had progressively decreased spirometric test values. It is concluded that chronic exposure to tobacco smoke in the work environment decreases small-airway function in nonsmokers.

WHITECROSS D P, CLARKE A D, PIPER D W 893
THE EFFECT OF CIGARETTE SMOKING ON HUMAN GASTRIC SECRETION
SCANDINAVIAN JOURNAL GASTROENTEROLOGY 9(4):399-403, 1974

The effect of cigarette smoking on gastric secretion was studied in 13 control subjects and 8 subjects with chronic peptic ulcers. Gastric juices were collected from each subject after smoking 4 cigarettes in 1 hr. The output of acid, pepsin, and mucus was not different in either group or between the two, and was not influenced by the tar and nicotine content of the cigarettes. In the control subjects, biliary reflux was more marked in the hour that the subject smoked. Consequently, smoking does not seem to influence gastric secretion or ulcer healing.

WILKINS J, CARLSON H E, VANAKIN H V, HILL M A, ET AL.
296

NICOTINE FROM CIGARETTE SMOKING INCREASES CIRCULATING LEVELS OF CORTISOL, GROWTH HORMONE, AND PROLACTIN IN MALE CHRONIC SMOKERS
PSYCHOPHARMACOLOGY 78:305-308, 1982

Serial blood samples were collected while chronic smokers smoked conventional and low-nicotine cigarettes (0.2-2.0 mg). Circulating cortisol, growth hormone (GH), and prolactin (PRL) were measured and compared with heart rate (HR) and circulating nicotine. Differences between nicotine and low-nicotine groups for plasma cortisol, GH, and PRL were found. Mean plasma GH, PRL, and HR increased for nicotine group (2 mg). Nicotine induced elevations of circulating cortisol. GH and PRL were associated with a 25% increase in HR at 10 min; HR and plasma nicotine levels were maximal at 10 min and decreased linearly over the 60 min experimental interval. At 60 min, HR approached baseline, but plasma nicotine remained elevated.

WILKINSON A R, JOHNSON D 269
 INHIBITORY EFFECT OF CIGARETTE SMOKING ON GASTRIC SECRETION
 STIMULATED BY PENTAGASTRIN IN MAN
 THE LANCET 2:628-632, 1971

The effects of cigarette smoking on submaximal pentagastrin-stimulated gastric secretion were determined in patients with duodenal or peptic ulcers and in normal subjects. Cigarette smoking produced inhibition of pentagastrin-stimulated gastric acid secretion in normal subjects and in patients with duodenal or peptic ulcers. Acid output decreased after smoking in 25 subjects. Inhibition produced by 2 cigarettes was not significantly greater than inhibition produced by 1 cigarette. Inhibition was as great in smokers as in nonsmokers. No significant change in acid output was observed during constant pentagastrin infusion in normal subjects and in patients with peptic ulcer who puffed on dummy cigarettes. Acid concentration decreased in normal subjects; in duodenal ulcer patients; and in gastric ulcer patients. No significant decrease in acid concentration was observed in normal subjects and peptic ulcer patients who did not smoke. The mean pepsin output decreased in 11 normal subjects and in 10 duodenal ulcer patients. No significant change in pepsin output was observed in the 4 gastric ulcer patients. Smoking 1 cigarette elicited acid output decreases of 2%, 78%, and 42% in subjects who received nicotine acid tartrate (1, 3, 4 mg). Decrease in acid output after infusion of nicotine (3 mg) was similar to the decrease produced by cigarette smoking; however, failure of nicotine (4 mg) to produce inhibition was unexplained. Cigarette smoking produces inhibition of pentagastrin-stimulated gastric acid secretion in normal subjects and in patients with duodenal or gastric ulcers.

WILLGOOSE C E 603
 TOBACCO SMOKING STRENGTH AND MUSCULAR ENDURANCE
 RESEARCH QUARTERLY 18:219-225, 1947

In the present experiment, 15 men (habitual smokers, 20-25 yr of age) tested the effect of smoking 1 cigarette on fatigue and strength of flexor muscles of the hand and forearm. For the first series of tests, subjects were allowed to smoke their own cigarette during the 3-min rest. Each subject smoked 50% of 1 cigarette. During the second series of tests, subjects rested without smoking during the 3-min rest interval. Mean values were calculated for each test. A characteristic curve started with the subject's best grip, dropped through 6 min of testing, recovered a little after 3-min interval of rest or rest and smoking; then it dropped through 4 min of gripping, recovering somewhat after 5 min of rest. Comparison of the percent recovery of the first test (due to smoking and rest) and the percent recovery of the second test (due to rest alone) indicated that in every case, the percent of recovery was greater for the non-smoking tests than for the smoking tests. Abstinence from nicotine during physical education training routine is recommended.

WILLIAMS G D 294
EFFECT OF CIGARETTE SMOKING ON IMMEDIATE MEMORY AND PERFORMANCE
IN DIFFERENT KINDS OF SMOKER
BRITISH JOURNAL PSYCHOLOGY 71:83-90, 1980

Changes in performance resulting from smoking were assessed in 48 male smokers. Subjects completed 1) a questionnaire on smoking habits, 2) the Eysenck Personality Questionnaire, and 3) the Frith SSQ. In the letter cancellation task subjects were required to work as fast as possible without errors crossing out each instance of an "E" found in sheets of randomly ordered letters arranged in lines of 30 letters. Average pains in letters cancelled (with different cigarettes smoked) increased in both low and high arousal groups with the greatest increase being in the medium/moderate nicotine cigarette. Gains in immediate-memory errors occurred in both low and high arousal subjects. The greatest gain was in the strong/high nicotine cigarette (low arousal subjects) and medium/moderate nicotine cigarette (in high arousal subjects). With increasing cigarette strength, gains in letter cancellation speed on smoking increased although an inverted-U relation was suggested; immediate memory accuracy progressively deteriorated. Smokers with greater desire to smoke in situation of low arousal appeared to react more strongly to cigarettes and showed superior gain in cancellation speed on smoking.

WILLIAMS J, SHIELDS C E 363
CARBON MONOXIDE AND THE BLOOD DONOR
DTIC TECHNICAL REPORT NO. AD750581, 1982

Effects of smoking on blood carbon monoxide (CO) levels were determined in subjects (n = 112) prior to blood donation. Subjects (22 of 79 smokers, 17 of 33 nonsmokers) exercised 3-4 min before baseline blood samples were collected. CO baseline levels for exercise smokers averaged 4.1%; for nonexercised smokers, 4.4%. A 10% decrease was observed for the exercise group as opposed to the nonexercise group. Of the exercised smokers, 79% showed a decrease in CO baseline levels; of the nonexercised smokers, 69% showed a decrease. CO baseline levels for exercised nonsmokers average 1.7%; for nonexercised nonsmokers 1.8%. Some nonsmokers had individual CO baseline decreases which consisted of only 29% of exercised group and 37% of the nonexercised group. Although blood donors can increase their blood CO level by smoking prior to donation, brief exercise prior to donation decreases their blood CO level.

WINTERNITZ W, QUILLEN D 277
 ACUTE HORMONAL RESPONSE TO CIGARETTE SMOKING
 JOURNAL OF CLINICAL PHARMACOLOGY 17:389-392, 1977

Hormonal response to cigarette smoke inhalation was determined in habitual male smokers (n = 17) after smoking 8 cigarettes within 2 hrs on 2 consecutive days. A nonsmoking day served as the baseline. Plasma samples were assayed for glucose, nonesterified fatty acids, growth hormone (GH), follicle stimulating hormone (FSH), luteinizing hormone (LH), cortisol, insulin, and urinary catecholamines. A sharp increase in cortisol occurred after 2 cigarettes which was maintained through the second hr and fell slowly after the smoking period. Circulating GH increased after 2 cigarettes, peaked at 1 hr, and then decreased to control values while smoking continued. Urinary catecholamines were more increased on smoking days than on nonsmoking days; however, results were variable. LH, FSH, testosterone, insulin, and TSH showed no significant variations during the smoking period as compared to the nonsmoking period. Cigarette smoking activates pituitary secretion in habitual male smokers.

WOODSON P P, BAETTIG K, ETKIN M W 62
 EFFECTS OF NICOTINE ON THE VISUAL EVOKED RESPONSE
 PHARMACOLOGY BIOCHEMISTRY BEHAVIOR 17:915-920, 1982

Subjects were 10 males because the female menstrual cycle affects electroencephalogram (EEG). Nicotine (i.e., 1.3 vs 0.14 mg) generally increased peak-to-peak amplitudes for all components at most of the intensities. However, this was so only for component III-IV. None of the peak latencies showed differences due to dosage. Flash intensity affected the peak-to-peak amplitudes of components CD-I, I-II, and III-IV. These peak-to-peak amplitudes tended to increase with intensities 1, 2, and 4 and then to level off for intensities 8 and 16. Flash intensity also affected the latencies of peak III and peak IV. These peak latencies tended to decrease with increasing intensity. Both nicotine dosage and flash intensity had effects on peak-to-peak amplitude, while only flash intensity affected peak latency. Nicotine may augment visual attentional processes in the quiescent smoker.

WOODSON P P, BUZZI R, NIL R, BAETTIG K 323
 EFFECTS OF SMOKING ON VEGETATIVE REACTIVITY TO NOISE IN LIGHT
 VERSUS DEEP INHALERS
 EXPERIENTIA 41(6):836, 1985

The effect of depth of smoke inhalation (nicotine exposure level) on subjective and psychophysiologically measured stress reactivity was examined in 12 deep inhalers and 12 light inhalers.

Psychophysiological stress reactivity to environmental noise bursts (95 dBA peak intensity) was measured continuously before and after smoking (following 15 hours of smoking abstinence). These measures consisted of electrocardiogram, photoplethysmogram, pulse transit time, electromyogram, respiration, and skin conductance. Subjective stress levels were reported after each noise burst. Results indicated that light inhalers derive greater stress dampening effect from less nicotine exposure than deep inhalers derive from more nicotine exposure.

WRIGHT I S, MOFFAT D 874
THE EFFECTS OF TOBACCO ON THE PERIPHERAL VASCULAR SYSTEM
JOURNAL AMERICAN MEDICAL ASSOCIATION 103:318-323, 1934

The effect of tobacco on the peripheral vascular system was studied by measuring the surface temperature of subjects who smoked a standard, denicotinized, mentholated, or filter-paper cigarette. For those smoking the standard, denicotinized, and mentholated cigarettes, surface temperature at the finger tips showed a definite drop and the blood flow through the nail fold definitely slowed. The differences between groups were negligible. For those who smoked the filter-paper cigarettes, surface temperature and blood flow showed no changes. Because profound temperature and symptomatic reactions were found among experienced and habitual smokers, it seemed that habitual smoking does not develop immunity to the toxins of cigarette smoke. This evidence indicates that nicotine is a toxic factor in smoking.

WYNDER E L, KAUFMAN P L, LESSER R L 221
A SHORT-TERM FOLLOW-UP STUDY ON EX-CIGARETTE SMOKERS WITH SPECIAL EMPHASIS ON PERSISTENT COUGH AND WEIGHT GAIN
AMERICAN REVIEW RESPIRATORY DISEASES 94(4):645-655, 1967

This study involved interviews with 224 ex-cigarette smokers. The only criterion used in subject selection was that they had been regular cigarette smokers who had given up the habit at least 3 months but less than 10 years before the interview. More than three-fourths of the smokers experienced one or more withdrawal symptoms on cessation of smoking. The more a subject smoked, the greater the number of withdrawal symptoms experienced. These consisted principally of the urge to have something in the mouth (59 percent), and inability to concentrate or disorientation (20 percent). Persistent bronchial cough showed the most change, ceasing in 77 percent of subjects and improving in 17 percent. Throat clearing stopped in 51 percent of the smokers and improved in 22 percent. Weight gain was noted in 68 percent of ex-smokers.

WYNDER E L, KAUFMAN P L, LESSER R L 242
A SHORT-TERM FOLLOW-UP STUDY ON EX-CIGARETTE SMOKERS
AMERICAN REVIEW RESPIRATORY DISEASES 96:645-655, 1967

Of 197 individuals examined after cessation of smoking, the following withdrawal symptoms were observed: urge to have something in the mouth, in 116; increased nervousness and irritability, in 102; inability to concentrate and disorientation, in 40; insomnia, in 22; general mental fatigue, in 21; constipation, in 13; general gastrointestinal discomfort, in 9; sporadic tachycardia, in 8; prickling in fingers, in 8; and skin rashes, in 3. Bronchial cough (n = 109) ceased in 83 individuals, improved in 19 individuals, and did not change in 7 individuals. Throat clearing (n = 55) stopped in 28 individuals, improved in 12 individuals, and did not change in 15 individuals. Appetite (n = 223) increased in 148 individuals, did not change in 74 individuals, and decreased in 1 individual. Food intake (n = 224) increased in 149 individuals, decreased in 8 individuals, and did not change in 64 individuals. Of the former smokers, 68% gained weight. The study clearly revealed the presence of withdrawal symptoms (of undetermined physiologic and psychological origins) among subjects who gave up smoking.